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BEFORE THE IDAHO PUBLIC UTILITIES COMMISSION

IN THE MATTER OF THE APPLICATION OF AVISTA CORPORATION FOR A FINDING OF PRUDENCE FOR 2014-2015 EXPENDITURES ASSOCIATED WITH PROVIDING ELECTRIC AND NATURAL GAS ENERGY EFFICIENCY SERVICE IN THE STATE OF IDAHO	CASE NO. AVU-E-16-06 [redacted]
	EXHIBIT NO. 2
	LYNN ROY
	REPRESENTING Nexant, Inc

FOR AVISTA CORPORATION

(ELECTRIC AND NATURAL GAS)

REPORT

Nexant

Reimagine tomorrow.

Impact Evaluation of Idaho 2014-2015 Energy Efficiency Programs

Submitted to Avista Utilities

June 2, 2016

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1 Executive Summary

Nexant Inc. and Research Into Action (collectively the evaluation team) conducted an impact and process evaluation of Avista's 2014 and 2015 residential and nonresidential energy efficiency programs. This report documents findings from the impact evaluation activities for Avista's Idaho electric programs. The primary goal of this evaluation was to provide an accurate summary of the gross energy and demand savings attributable to the following Avista programs offered in 2014 and/or 2015:

- Nonresidential Prescriptive
- Nonresidential Site Specific
- Residential Appliance Recycling
- Residential Heating, Ventilation and Air Conditioning (HVAC)
- Residential Water Heat
- Residential ENERGY STAR® Homes
- Residential Fuel Efficiency
- Residential Lighting
- Residential Shell
- Residential Opower Behavioral
- Low Income

1.1 Evaluation Methodology and Activities

The evaluation team performed the impact evaluation through a combination of document audits, customer surveys, engineering analysis and onsite measurement and verification (M&V) of completed program projects. Because it is not cost-effective to complete analysis and onsite inspection on a census of the implemented projects, the evaluation team verified energy savings for a representative sample of projects to draw statistically-measurable results. The gross verified program savings were adjusted by a realization rate (RR), which is the ratio of evaluation verified savings to the program-reported savings within the sample.

The evaluation team conducted more than 525 document audits, approximately 360 customer surveys, and nearly 250 onsite inspections across the residential and nonresidential programs being evaluated (Table 1-1). In addition, the evaluation team conducted billing regression analysis to estimate the impacts of five residential programs and on a case-by-case basis for the nonresidential projects. The samples were designed to meet a 90% confidence and 10% precision level at the portfolio and sector level and were based upon the expected and actual significance (or magnitude) of program participation, the level of certainty of savings, and the variety of measures.

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Table 1-1: Summary of Impact Evaluation Activities

Program	Document Audit	Surveys	Onsite M&V	Billing Analysis
Residential				
Residential Appliance Recycling	70	72	0	
HVAC Program	68	68	0	√
Water Heat Program	24	13	0	
ENERGY STAR Homes	19	16	0	
Fuel Efficiency	26	25	0	√
Residential Lighting Program	0	0	75	
Shell Program	28	28	0	√
Opower Behavioral Program	0	0	0	√
Low Income	24	0	0	√
Nonresidential				
Prescriptive Lighting	68	22	22	
Prescriptive EnergySmart Grocer	44	20	20	
Prescriptive Non-Lighting Other	24	15	15	
Site Specific	101	84	84	as applicable
Small Business*	31		31	
TOTAL	**527**	**363**	**247**	

*There was no participation in the Small Business program in Idaho in 2015 and the evaluation activities were conducted on Washington participants.

1.2 Summary of Impact Evaluation Results

Avista's Idaho electric 2014 and 2015 programs achieved more than 80 GWh of savings over the two year period (Table 1-2). Table 1-3 and Table 1-4 summarize Avista's 2014 and 2015 impact evaluation results by sector and program.

Table 1-2: 2014-2015 Idaho Electric Portfolio Evaluation Results

Sector	Reported Savings (kWh)	Realization Rate (%)	Gross Verified Savings (kWh)
Residential	18,772,837	97%	18,281,513
Nonresidential	12,379,360	94%	11,687,224
Low Income	758,955	147%	1,112,301
PORTFOLIO	**31,911,152**	**97%**	**31,081,038**

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Table 1-3: Idaho Electric Nonresidential Program Evaluation Results

Program	2014-2015 Reported Savings (kWh)	Realization Rate	2014-2015 Verified Gross Savings (kWh)
EnergySmart Grocer	2,387,662	90%	2,138,035
Food Service Equipment	130,946	54%	70,971
Green Motors	43,954	54%	23,823
Motor Controls HVAC	466,340	54%	252,751
Commercial Water Heaters	190	54%	103
Prescriptive Lighting	3,475,049	99%	3,432,865
Prescriptive Shell	54,381	54%	29,474
Fleet Heat	7,228	54%	3,917
Site Specific	5,813,610	99%	5,735,284
TOTAL NONRESIDENTIAL	**12,379,360**	**94%**	**11,687,224**

Figure 1-1: Idaho Electric Nonresidential Sector Program Gross Verified Saving Shares

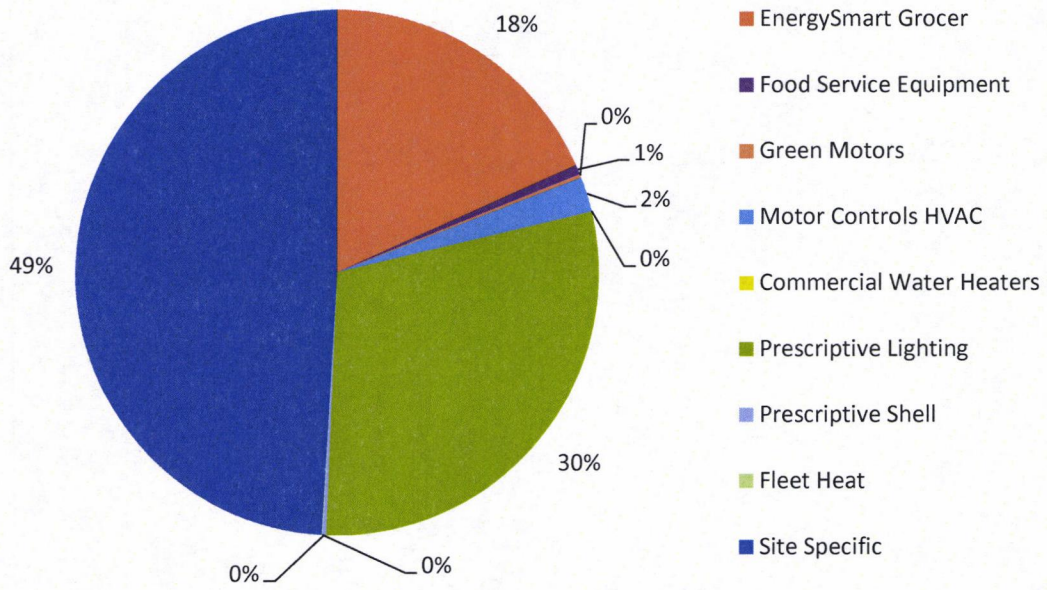

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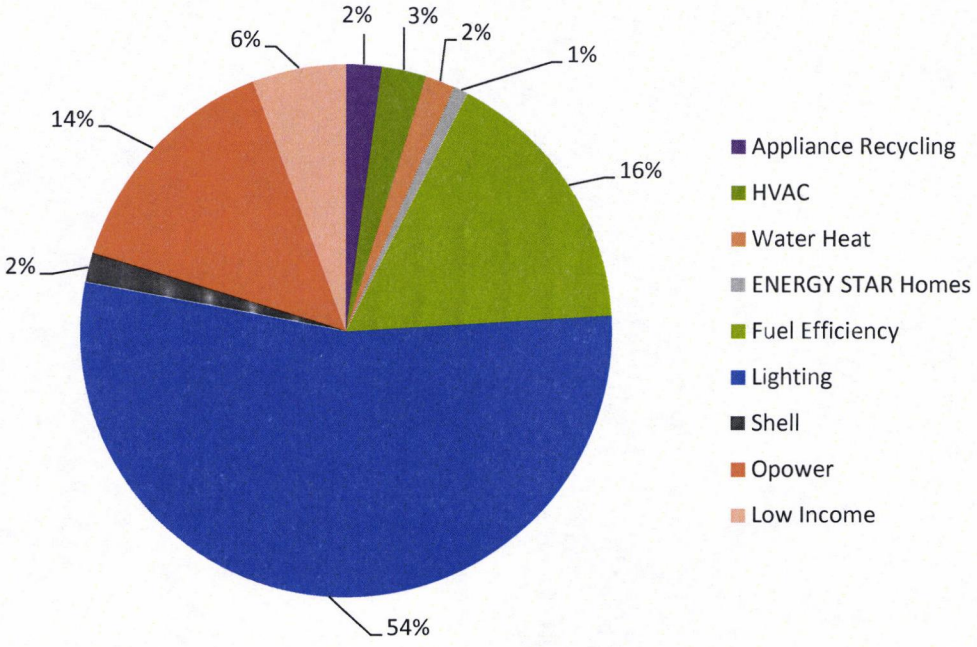
Table 1-4: Idaho Electric Residential Program Evaluation Results

Program	2014-2015 Adjusted Reported Savings (kWh)	Realization Rate	2014-2015 Gross Verified Savings
Appliance Recycling	250,920	166%	416,524
HVAC	872,828	60%	521,365
Water Heat	239,267	148%	354,675
ENERGY STAR Homes	140,538	123%	173,120
Fuel Efficiency	5,295,779	60%	3,198,893
Lighting	8,323,842	126%	10,457,288
Shell	903,663	38%	345,048
Opower	2,746,000	102%	2,814,601
Low Income	758,955	147%	1,112,301
TOTAL RESIDENTIAL	**19,531,792**	**99%**	**19,393,814**

Figure 1-2: Idaho Electric Residential Sector Program Gross Verified Saving Shares



1.3 Conclusions and Recommendations

The following outlines the key conclusions and recommendations as a result of the evaluation activities. Specific details regarding the conclusions and recommendations outlined here, along

with additional conclusions and recommendations can be found in the program-specific sections of this report and in Section 7.

1.3.1 Nonresidential Programs

The overall realization rate for the nonresidential portfolio is 94%. The realization rates ranged from 99% for the Site Specific and Prescriptive Lighting programs down to 54% for the "Prescriptive Non-Lighting Other" program. The Site Specific and Prescriptive Lighting programs are the largest programs in the portfolio, together representing 75% of the portfolio's gross verified savings. The evaluation team found that the processes Avista is utilizing for estimating and reporting energy savings for the nonresidential programs are predominantly sound and reasonable. The following subsections outline specific key conclusions and recommendations for several of the nonresidential programs.

Conclusion: The Site Specific program constitutes almost 50% of the program energy shares. Within the last 2 years, Avista has increased their level of quality assurance and review on projects that participate through the program. The evaluation team's analysis resulted in a 99% realization rate for the Site Specific program. The high realization rate indicates that Avista's internal process for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts.

> **Recommendation**: The evaluation team recommends that Avista continue to operate this program with the current level of rigor. For interior lighting projects, Avista should consider applying the interactive factors deemed by the Regional Technical Forum (RTF) to quantify the interactive effects between lighting retrofits and their associated HVAC systems.

Conclusion: Avista's EnergySmart Grocer program is successfully providing retail and restaurant customers with an avenue to upgrade their refrigeration equipment. Participation in the program includes both prescriptive and custom projects. The evaluation team's review of projects in the program resulted in a realization rate of 90%. For prescriptive projects, the evaluation team determined that RTF deemed savings values were being appropriately applied in most cases. However, low project-level realization rates for custom projects, which tend to be larger in size than prescriptive projects, are driving the program realization rate downward.

> **Recommendation**: Avista should consider more internal review of energy savings estimates submitted by vendors for custom projects under this program. Alternatively, Avista could consider tracking custom projects under the Site Specific program with other projects of similar size and complexity.

Conclusion: Avista reported 2014-2015 participation in six other prescriptive programs. Of these, the HVAC Motor Controls program is the largest, constituting 66% of the energy savings for this group. The evaluation team's review of projects in these programs resulted in a 54% realization rate. Cases of ineligible VFD projects receiving incentives were cause of the low realization rate for these programs.

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Recommendation: Avista should revise the HVAC Motor Controls program to include more verification of motor eligibility status. More emphasis should be placed on confirming motor application and duty status to ensure compliance with the program's existing eligibility requirements. More specifically, Avista should place specific emphasis on ensuring VFDs are installed in a manner that saves energy (i.e. not just as "soft starters") and that incentivized VFDs serve primary-duty motors.

Conclusion: The Small Business reported savings for faucet aerators were found to be conservatively low based upon the evaluation team's secondary research. The realization rates for faucet aerators were 126% for electric savings and 204% for natural gas savings.

Recommendation: It is recommended that the modified deemed savings values utilized by the evaluation team be adopted by the program for future reporting purposes.

1.3.2 Residential Programs

The overall realization rate for the residential and low income portfolio is 99%. The realization rates varied significantly across the various programs evaluated with the Shell, HVAC, and Fuel Efficiency programs having the lowest realization rate (38% and 60% respectively). The evaluation team found that the reported savings for the majority of the programs were understating the actual impacts found from the evaluation activities. The following subsections outline specific conclusions and recommendations for several of the residential programs.

Conclusion: The evaluation team found that the reported deemed savings value (per recycled unit) for the program was lower than estimated gross savings valued from prior studies. Avista may have aligned their deemed savings values close to the RTF deemed savings values, but it is important to understand that the RTF is reporting a value that accounts for net market effects (i.e. free ridership).

Recommendation: If Avista chooses to offer an appliance recycling program in the future, it is recommended that a clear distinction between gross and net savings values is noted if Avista reports the most current RTF values.

Conclusion: The evaluation team found, through billing regression analysis, a relatively low realization rate for the Air Source Heat Pump (ASHP) measures (RR of 49%).

Recommendation: The evaluation team recommends Avista reexamine the assumptions relating to annual per-home consumption and savings estimates in homes receiving ASHP installations. In addition, to help better understand the baseline for the ASHP replacement, Avista could consider requesting that contractors and customers provide a better description of the replaced unit

Conclusion: For showerheads distributed through the Simple Steps program, Avista allocates 50% of its reported savings to electric savings and 50% to natural gas savings to account for homes that have different water heating fuel types.

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Recommendation: The evaluation team recommends Avista update this allocation assumption to be based on representative water heater fuel type saturation. These data are available through the Regional Building Stock Assessment study; however, we recommend Avista base the allocation on data specific to its territory.

Conclusion: The evaluation team conducted a billing regression analysis for the Fuel Efficiency participants and found realization rates of 57-62% for rebate projects that included the conversion of a home's heating system from electricity to natural gas. When regression coefficients were examined in detail, the evaluation team noted that the estimated reduction in electric heating load was being offset by an increase in estimated base load within participating homes.

Recommendation: Because the rebate amounts and per-home savings from Fuel Efficiency are so large and the number of participants is relatively low, the evaluation team recommends Avista ask participating customers for details on any additional home renovations that were completed in parallel with the fuel conversion. Home improvement projects such as an addition, finishing a basement, or adding air conditioning can drastically change the consumption patterns within a home and render the assumed baseline inaccurate.

Conclusion: The evaluation team found that over half the homes receiving Fuel Efficiency rebates in 2014-2015 did not have a gas billing history with Avista prior to the conversion. These homes realized savings at a higher rate than homes that did have previous gas service.

Recommendation: The evaluation team recommends that Avista consider adding a field to the program tracking database that indicates the gas meter installation date or service start date of participating homes. This would more clearly delineate homes that were previously all electric and became dual-fuel around the same time as the Fuel Efficiency project, from homes that had been dual-fuel historically. Avista may also want to consider assuming a more conservative electric savings estimate for homes that had prior gas service because it's possible that the home was not 100% electrically heated prior to program participation.

Conclusion: Avista's deemed savings estimates, which were generally the same for all similar product types and not correlated to the bulb wattage, understated the savings found by the evaluation team. This was especially the case for Avista's CFL giveaway program.

Recommendation: The evaluation team recommends that Avista consider more detailed product type deemed values in an effort to be more closely aligned with the actual participating lamps. Simple Steps has shifted its program tracking to specific product types by lumen bins in accordance with the most current BPA UES measure list. Avista should consider using these higher resolution deemed value for internal reporting with the Simple Steps program and for use with internal residential lighting programs.

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Recommendation: An overarching recommendation related to the Residential Lighting, is that Avista monitor the LED lamp market for technology cost changes and customer preferences, and consider increasing LED lamp options from the 2014-2015 portfolio in future DSM planning. Currently, LED prices are dramatically decreasing and customer preferences are shifting from CFL to LEDs as a preferred choice as an energy efficient technology. Consequently, CFLs shelf space share is declining as an abandoned technology, despite its better cost effectiveness compared to LED lamps.

Conclusion: The evaluation team found a low realization rate (38%) for shell rebate measures (windows and insulation). This finding indicates that reported savings values were too aggressive on average. The evaluation team compared the end-use shares estimated via regression analysis and found that only approximately 5,500 of the 13,000 kWh of average annual consumption in residential homes in Avista's service territory was assigned to heating and cooling load. Given this end-use share, the reported savings values claimed by Avista equate to a 25% reduction in HVAC loads.

> **Recommendation:** The evaluation team recommends Avista examine planning assumptions about per-home consumption, end-use load shares, and percent reductions in heating and cooling loads from shell improvements. It may be that the percent reduction assumptions are sound, but they are being applied to an overstated assumption of the average electric HVAC consumption per home. Conversely, the assumed end-use shares may be accurate, but the end-use reduction percentage is inflated. This investigation should be conducted separately for electrically heated homes and dual fuel homes as the heating electric end-use share will be different.

Conclusion: The evaluation team found that savings held fairly consistent during the 6 month interruption in Home Energy Report delivery. The finding reinforces Avista's decision to assume a multi-year measure life when calculating the cost-effectiveness of the Opower program.

> **Recommendation:** The evaluation team recommends Avista examine the program delivery model in the 2016-2017 cycle. Given the fixed and volumetric nature of program costs, measure life assumptions, and mechanisms by which measured savings are counted toward goal achievement the evaluation team believes there are alternatives to the traditional delivery model that optimize program achievements relative to costs.

Conclusion: The evaluation team found a high realization rate for the fuel conversion measures implemented through the Low Income program. One reason for the high realization rate could be due to the fact that Avista caps the reported savings value to 20% of the contractor estimated savings. In addition, the evaluation team found that the verified savings for these fuel conversion measures aligned closely with the verified savings found through the regular-income Fuel Conversion program.

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Recommendation: The evaluation team recommends re-evaluating the current savings cap for fuel conversion projects. In addition, we recommend that Avista align assumptions for fuel switching savings for the Low Income and Fuel Efficiency programs.

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2 Introduction

2.1 Purpose of Evaluation

The purpose of the impact evaluation was to verify the savings attributed to Avista's 2014–2015 rebate programs and to identify areas for future program opportunities. The evaluation team estimated gross program energy impacts through a combination of documentation audits, and telephone surveys, as well as engineering analysis and site inspections of completed program projects.

2.2 Program Summary

The following section provides a description of each program we evaluated in Idaho. Although the program descriptions outline electric and gas measures, as applicable, the remainder of this report provides the methodology and findings for the electric-only measures and programs.

2.2.1 Nonresidential

The nonresidential energy efficiency market is delivered through a combination of prescriptive and site-specific offerings. Any measure not offered through a prescriptive program is automatically eligible for treatment through the site-specific program, subject to the criteria for participation in that program. Prescriptive paths for the nonresidential market are preferred for measures that are relatively small and uniform in their energy efficiency characteristics. The following subsections provide a summary of Avista's Site Specific and Prescriptive programs, including a description of program offerings, measures, and incentive amounts.

2.2.1.1 Site Specific

Avista's Site Specific program offers nonresidential customers the opportunity to propose any energy efficiency project outside the realm of Avista's other programs. Any project with documentable energy savings (kilowatt-hours and/or therms) and a minimum ten year measure life can be submitted for a technical review and potential incentive through the Site Specific program. The majority of projects that participate in this program are appliance upgrades, compressed air, HVAC, industrial process, motors, shell improvements, custom lighting, and natural gas multifamily market transformation projects. Multi-family residential developments may also be treated through the Site Specific program when the majority of the units and common areas are receiving the efficiency improvement. The determination of incentive eligibility is based upon the project's individual characteristics as they apply to the Company's electric Schedule 90 or natural gas Schedule 190 tariffs.

Customers or their representative are required to contact Avista for a Site Specific analysis prior to any equipment being purchased or installed. Based on the post-verification process, incentives may not be offered after the installation of energy efficiency equipment or process under this program design. Table 2-1 shows the incentive levels associated with designated

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ranges of project simple payback periods. To be eligible for incentive, lighting measures must have a simple payback period less than 8 years and all other measures must have a simple payback period less than 13 years. Simple payback is calculated as the incremental cost of a measure divided by the annual energy savings of the measure, calculated using the customer's Avista electric and/or gas rate. Incremental costs are only those projects costs necessary for the energy efficiency improvement.

Table 2-1: Site Specific Program Measures

Category	Required Payback Period	Incentive Level ($ / Saved kWh)
All Measures	Between 1 and 2 years	$0.08
	Between 2 and 4 years	$0.12
	Between 4 and 6 years	$0.16
Most Lighting Measures1	Between 6 and 8 years	$0.20
	Greater than 8 years	Not eligible
All Other Measures	Between 6 and 13 years	$0.20
	Greater than 13 years	Not eligible

[1]Lighting measures with independently verified lives of less than 40,000 hours.

Avista internally implements the Site Specific program following a multi-stage internal process outlined in Figure 2-1. To be considered for incentives, Avista must receive notification of a potential project during the planning stage. Avista engineers generate energy analyses and savings estimates for each project.

These energy savings estimates are subjected to a rigorous internal review process, with the level of review dependent on the potential incentive level for the project. Avista's current internal review guidelines are as follows:

- Measures that have an incentive of $0 and an energy based simple payback of over 20 years require no report and no review, just a form letter to the customer.
- Measures that have incentives between $1 and $2,000 will be processed by the reporting engineer without any other review.
- Measures that have incentives between $2001 and $25,000 will be reviewed before going to the customer by another qualified engineer.
- Measures over $25,000 will be reviewed by another qualified engineer with an additional technical management review prior to releasing to the customer.
- Measures over $40,000 will be reviewed by another qualified engineer, a technical manager, and an additional director review prior to releasing to the customer.

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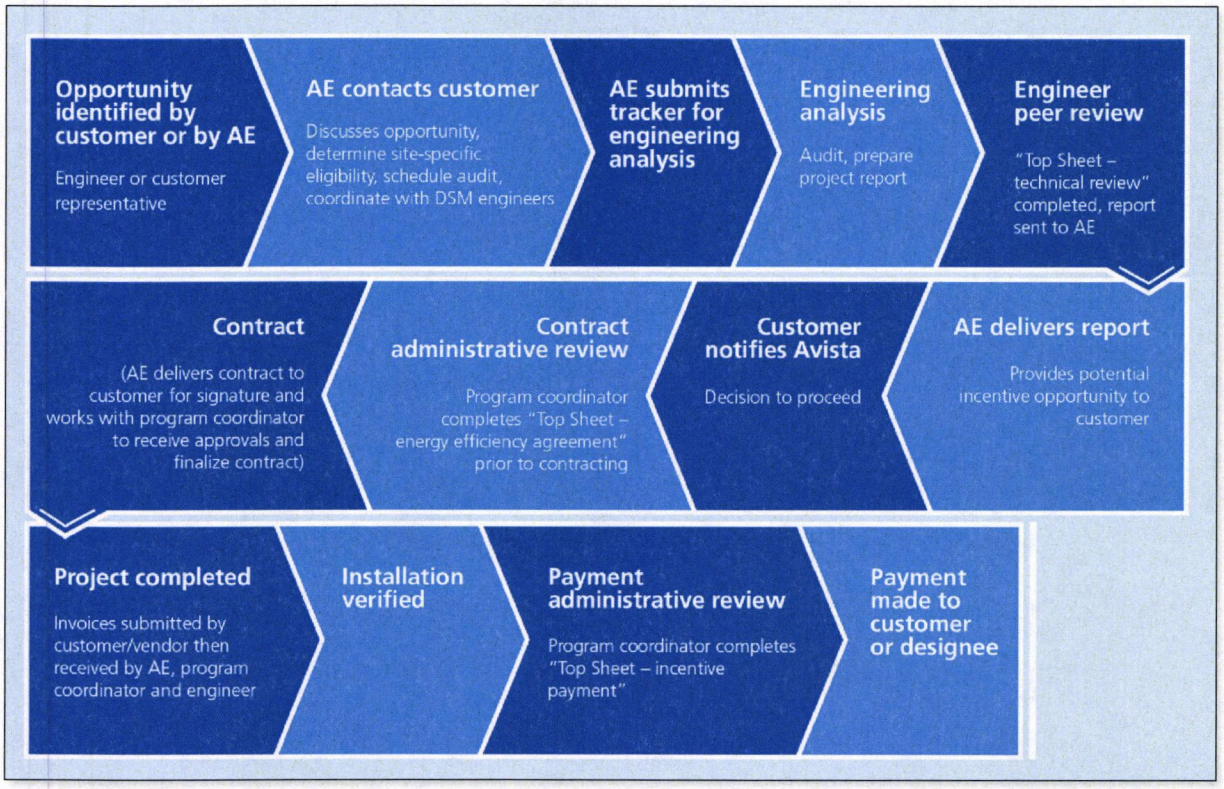
Avista employs the use of a "Technical Review Top Sheet" at each stage of the review process. The Top Sheet is a checklist intended to ensure that all program processes and policies have been followed and that project documentation is complete.

An "Energy Efficiency Evaluation Report" is generated for each project that includes a summary of the project's scope of work, estimated energy savings and incentives. Following project installation, Avista program staff members perform installation verification on nearly 100% of projects with limited exceptions. Program staff follows an "Incentive Payment Top Sheet" prior to incentive payment, which is another checklist to ensure that the project has been appropriately documented, tracked, and finalized.

Figure 2-1: Site Specific Program Process[1]



2.2.1.2 Prescriptive Lighting

The Prescriptive Lighting program is designed to make lighting improvement projects more accessible for Avista's nonresidential customers. This program is implemented internally by Avista, and existing commercial or industrial facilities with electric service provided by Avista with rate schedules 11 or above are eligible to participate. The program provides a pre-determined incentive amount for many common lighting retrofits, as shown in Table 2-2. Installed LED lighting must comply with nationally recognized specifications set forth by ENERGY STAR and Design Lights Consortium (DLC) and the Seattle Lighting Design Lab.

[1] Washington Demand Side Management Standard Operation Procedures. Avista Utilities. 2015.

Avista's regionally-based Account Executives (AEs) are a key part of delivering the Prescriptive Lighting program along with area vendors and contractors.

Table 2-2: Prescriptive Lighting Program Measures

Measure	$ Incentive/ Unit
250 watt HID Fixture to 4-Lamp High Performance (HP) T8 Fixture HO or 2-Lamp T5HO Fixture	$ 90
250 watt HID Fixture to 4-Lamp HP T8 Fixture HO or 2-Lamp T5HO 5-foot Fixture with occupancy sensor	$120
400 watt HID Fixture to 4-Lamp T5 Fixture	$120
400 watt HID Fixture to 4-Lamp T5 Fixture with oc sensor	$150
400 watt HID Fixture to 6-Lamp HP T8 Fixture	$120
400 watt HID Fixture to 6-Lamp HP T8 with oc sensor	$150
400 watt HID Fixture to 8-Lamp HP T8 Fixture (4-Foot Lamps)	$125
400 watt HID Fixture to 8-Lamp HP T8 Fixture (4-Foot Lamps) with oc sensor	$155
40 watt Incandescent to 6-10 watt LED*	$10
60 watt Incandescent to 9-13 watt LED*	$12
75-100 watt Incandescent to 12-20 watt LED*	$15
Over 150 watt Incandescent to 2L HP F32T8 Fixture	$40
20 watt MR16 (GU10 Base) to MR16 LED* 2-4 watt	$10
35 watt MR16 (GU10 Base) to MR16 LED* 4-6 watt	$11
50 watt MR16 (GU10 Base) to MR16 LED* 6-9 watt	$12
75-100 watt Incandescent to LED* Can Light Kit	$30
Fixture with no occupancy sensor to built in to with relays for room control (no switch sensors)	$30
4-Foot 4-Lamp T12/8 to 4-Foot 3-Lamp HP T8 Ballast with 25 or 28 watt Lamps	$32
4-Foot 4-Lamp T12/8 to 4-Foot 2-Lamp HP T8 Ballast with 25 or 28 watt Lamps	$35
4-Foot 3-Lamp T12/8 to 2X4 LED* Fixture	$60
4-Foot 3-Lamp T12/8 to 4-Foot 2-Lamp HP T8 Ballast with 25-28 watt Lamps	$15
4-Foot 2-Lamp T12/8 to 4-Foot 1-Lamp HP T8 Ballast with 25-28 watt Lamps	$13
4-Foot 1-Lamp T12/8 to 1-Lamp HP T8 Ballast with 25-28 watt Lamps	$13
8-Foot 4-Lamp T12/8 to 8-Foot 4-Lamp (8') or 8-Lamp (4') HP T8 Ballast with 25 or 28 watt Lamps	$54
8-Foot 2-Lamp T12/8 to LED* 2X4 Fixture	$80
8-Foot 1-Lamp T12/8 to LED* 1X4 Fixture	$40
T12 Sign Lighting to LED Retrofit	$17 / FT^2
Exterior-1000 watt HID to 400-575 watt DHID	$225
Exterior-400 watt HID to 250 watt DHD MH	$150
Exterior-400 watt HID to 122-175 watt LED*	$255

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Measure	$ Incentive/ Unit
Exterior-320 watt to 122-160 watt LED*	$180
Exterior- 250 watt HID to 85-140 watt LED* & 250 watt HID to New Construction 85-121 watt LED*	$145
Exterior-175 watt HID to 35-85 watt LED* & 175 watt HID to New Construction 35-85 watt LED*	$135
Exterior-150 watt HID to 35-50 watt LED*	$130
Exterior-90-100 watt HID to 25-50 watt LED*	$75
Exterior-70-90 watt HID to 15-35 watt LED	$55
Exterior-320 & 400 watt HID to New Construction 122-175 watt LED*	$180
Exterior-400 watt Canopy HID to 122-175 watt LED* Canopy Fixture	$325
Exterior-325 watt Canopy HID to 122-160 watt LED* Canopy Fixture	$250
Exterior-250 watt Canopy HID to 85-140 watt LED* Canopy Fixture	$155

2.2.1.3 EnergySmart Grocer

The EnergySmart Grocer program offers a range of proven energy-saving solutions for grocery stores and other customers with commercial refrigeration. The program was designed to offer personalized facility assessments to identify efficiency opportunities and incentives to offset the upfront costs of efficiency projects, making it easy and affordable for participating businesses to achieve significant savings on their utility bills. EnergySmart Grocer is administered by CLEAResult with Avista oversight.

The EnergySmart Grocer program is available to electric (Schedule 11, 12, 21, 25) or natural gas (Schedule 101, 111, 121) customers. The list of measures incentivized by this program is fluid and may change at any point in the year. Table 2-3 lists the measures offered at one point in 2015.

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Table 2-3: EnergySmart Program Measures

Measure	Incentive $/unit	Units
Cases		
Low Temp Open Case to Reach-in Case	$150	In ft of case
Medium Temp Open Case to Reach-in Case	$20	In ft of case
Low Temp Reach-in to High Efficiency Reach-in Case	$150	In ft of case
Low Temp Coffin to High Efficiency Reach-in	$55	In ft of case
Medium Temp Open Case to High Efficiency Open Case	$20	In ft of case
Special Doors with Low/No ASH for Low Temperature Reach-in	$200	door
Add doors to Open Medium Case	$85	In ft of case
Case Lighting		
Reach-in Case Light: T12 to Low Power LED, Retrofit	$21	In ft of LED
Reach-in Case Light: T8 to Low Power LED, Retrofit	$12	In ft of LED
Reach-in Case Light: T8 to Low Power LED, New Case	$12	In ft of LED
Reach-in Case Light: Add Motion Sensor to Low Power LED	$1.00	In ft of LED
Reach-in Case Light: Add Motion Sensor to High Power LED	$2.00	In ft of LED
Controls		
Anti-Sweat Heat – with Energy Management System	$14	In ft of case
Anti-Sweat Heat – without Energy Management System – Med Temp	$40	In ft of case
Anti-Sweat Heat – without Energy Management System – Low Temp	$40	In ft of case
Evaporated Fan - Walk-In ECM Controller - Low Temp - 1/10-1/20 HP	$35	Motor controlled
Evaporated Fan - Walk-In ECM Controller - Medium Temp - 1/10-1/20 HP	$35	Motor controlled
Strip Curtains, Gaskets & Auto-Closers		
Strip Curtains for Supermarket Walk-in Cooler	$5	sq ft
Strip Curtains for Supermarket Walk-in Freezer	$5	sq ft
Strip Curtains for Convenience Store Walk-in Freezer	$5	sq ft
Strip Curtains for Restaurant Walk-in Freezer	$5	sq ft
Gaskets for Walk-in Cooler – Main	$25	door
Gaskets for Walk-in Freezer – Main Door	$65	door
Gaskets for Reach-in Glass Doors, Medium Temp	$ 25	door
Gaskets for Reach-in Glass Doors, Low Temp	$ 40	door
Auto-Closers for Walk-in Freezers	$170	Closer
Auto-Closers for Walk-in Coolers	$25	Closer
Auto-Closers for Glass Reach-in Doors - Freezers	$35	Closer

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Measure	Incentive $/unit	Units
Auto-Closers for Glass Reach-in Doors - Coolers	$35	Closer
Motors		
Evaporator Motors - Shaded Pole to ECM in Display cases	$55	motor
Evaporator Motors - Shaded Pole To ECM in Walk-in ≤ 23 watts	$140	motor
Evaporator Motors - Shaded Pole To ECM in Walk-in > 23 watts	$140	motor
Floating Head Pressure on Singles, LT Condensing Unit	$100	hp
Floating Head Pressure on Singles, MT Condensing Unit	$100	hp
Floating Head Pressure on Singles, LT Remote Condenser	$100	hp
Floating Head Pressure on Singles, MT Remote Condenser	$100	hp

2.2.1.4 Food Service Equipment

The Food Service Equipment Program provides incentives for the purchase and installation of energy efficient commercial food service equipment to Avista's electric (Schedule 11, 12, 21, 25) and natural gas (Schedule 101, 111, 121) customers. Equipment must be commercial grade and must meet Energy Star or Fishnick specifications. Certified equipment is 10-70% more efficient than standard equipment, depending on product type. Types of rebated equipment include fryers, steam cookers, hot food holding cabinets, commercial convection ovens, dish washers, commercial ice machines, pre-rinse sprayers, and commercial rack ovens. Table 2-4 summarizes the incentives available under the Food Service Equipment program. Avista implements this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

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Table 2-4: Food Service Equipment Program Measures

Equipment	Incentive
Commercial Convection Ovens	
Commercial Convection Oven, Natural Gas	$700/ Each
Commercial Convection Oven, Electric	$225/ Each
Commercial Combination Oven, Natural Gas	$1,000/ Each
Commercial Combination Oven, Electric	$1,000/ Each
Dish Washers	
Commercial Low Temp Electric Hot Water	$600/ Each
Commercial High Temp Electric Hot Water	$650/ Each
Commercial Low Temp Natural Gas Hot Water	$300/ Each
Commercial High Temp Natural Gas Hot Water	$350/ Each
Commercial Ice Machines	
Under 200 LBS/Day Capacity	$40/Each
200-399 LBS/Day Capacity	$60/Each
400-599 LBS/Day Capacity	$80/Each
600-799 LBS/Day Capacity	$100/Each
800-999 LBS/Day Capacity	$120/Each
1000-1199 LBS/Day Capacity	$140/Each
1200-1399 LBS/Day Capacity	$160/Each
1400-1599 LBS/Day Capacity	$180/Each
1600-> LBS/Day Capacity	$200/Each
Pre Rinse Sprayers	
1 to 1.00 GPM Electric	$25
.61 to .80 GPM Electric	$25
.81 to 1.00 GPM Natural Gas	$25
.61 to .80 GPM Natural Gas	$25
Commercial Rack Ovens	
Commercial Rack Ovens, Natural Gas	$235

2.2.1.5 Green Motor Rewind

The Green Motors Rewind program is implemented by the Green Motors Practice Group with Avista oversight. This program is available to electric (Schedule 11, 12, 21, 25, 31) customers who receive a green motor rewind at a participating service center. To participate, customers must take an existing motor to a participating service center to have a green rewind done. Customers receive an automatic rebate applied at the service center of $1 per hp based on the size of the motor. Motors ranging from 15 to 5,000 hp are eligible to participate. Motor service centers must meet specific criteria to be qualified for the program.

Table 2-5: Green Motor Rewinds Program Measures

Measure	Eligible Motor Size	Rebate
Green Motor Rewind	15 – 5,000 hp	$1 / hp

2.2.1.6 Commercial HVAC Variable Frequency Drive (VFD) Program

This program encourages customers to increase HVAC pump and fan system efficiency through the installation of variable frequency drives (VFDs). Incentives are issued after measure installation. To be eligible for an incentive, a VFD must be installed on commercial heating, ventilation, and air conditioning equipment that is served by an Avista electric non-residential rate schedule (Schedule 11, 12, 21, 25). New construction projects are not eligible to participate. Additionally, only VFDs installed on primary pumps and fans are qualified. Secondary or spare pumps and fans do not qualify. Incentives are paid on a per-horsepower basis, depending on the application of the VFD, as shown in Table 2-6. Avista implements this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

Table 2-6: Motor Controls HVAC Program Measures

Measure	Incentive per HP
VFD Fans	$80
VFD Cooling Pump Only	$85
VFD Heat Pump only or Combined Heating & Cooling Pump	$140

2.2.1.7 Commercial Clothes Washers

The Commercial Clothes Washer Program provides incentives to Avista's electric (Schedule 11, 12, 21, 25) or natural gas (Schedule 101, 111, 121) customers for the purchase and installation of an energy efficient commercial clothes washers. Clothes washers must be commercial grade units and must meet ENERGY STAR™ commercial clothes washer specifications. To be eligible for incentive, the clothes washer must be served by hot water that is generated using an Avista fuel source (e.g. a natural gas hot water heater on Avista natural gas service). The types of equipment eligible to participate in this program are listed in Table 2-7. Avista implements this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

Table 2-7: Motor Controls HVAC Program Measures

Equipment	Rebate/ unit
ES Washer electric hot water and dryer	$75
ES Washer electric hot water and natural gas dryer	$75
ES Washer natural gas hot water and natural gas dryer	$75
ES Washer – natural gas hot water and electric dryer	$75

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2.2.1.8 Power Management for Personal Computer Networks

This program encourages implementation of power management software to obtain energy efficiency. Power management software saves energy by shifting personal computers to a low-power operating state after a specified period of inactivity. When deployed on a network serving multiple personal computers, this type of software can achieve significant energy savings. Eligibility for participation in this program includes confirmation of electric usage, and submission of pre- and post-install usage data. Post-installation reporting may be required for a period of three years. The incentive available for this program is $5 per license. Avista implements this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

Table 2-8: Power Management for PC Networks Program Measures

Measure	Incentive
PC Power Management Software	$5 / license

2.2.1.9 Commercial Windows & Insulation

The Commercial Windows & Insulation program offers incentives to Avista's non-residential electric (Schedule 11, 12, 21, 25) or natural gas (Schedule 101, 111, 121) customers for improvements to building envelopes through window upgrades and adding insulation. To participate in this prescriptive rebate program, customers must submit documentation of the project that includes post-installation R-values and affected square footage for insulation, and documentation of U-value, solar heat gain coefficient, and size for window replacements. The incentive levels for insulation project are dependent on the pre-and post-retrofit level of insulation. Avista implements this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

Table 2-9: Commercial Windows & Insulation Measures

Measure	Incentive ($ / sf)
Less than R4 Wall Insulation to R-11-R18 Retrofit	$0.30
Less than R4 Wall Insulation to R19 or above Retrofit	$0.35
Less than R11 Attic Insulation to R30-R44 Retrofit	$0.20
Less than R11 Attic Insulation to R45 or above Retrofit	$0.25
Less than R11 Roof Insulation to R30 or above Retrofit	$0.25
Windows U-Factor of .35 or less and SHGC .35 or Less (New Construction)	$0.50
Windows U-Factor of .35 or less and SHGC .35 or Less (Retrofit)	$0.50

2.2.1.10 Commercial Water Heaters

The Commercial Water Heaters program provides incentive to electric (Schedule 11, 12, 21, 25) or natural gas (Schedule 101, 111, 121) customers for the purchase and installation of an energy efficient commercial water heater. Water heaters must be commercial grade units and must be served by an Avista fuel source. An incentive of $20 per unit is provided for qualified water heaters. Water heater eligibility guidelines are outlined in Table 2-10. Avista implements

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this program in a prescriptive manner, and incentives are issued to the participating customer after the measure is installed.

Table 2-10: Commercial Water Heater Measures

Tank Size (gal)	Electric Energy Factor	Natural Gas Energy Factor	Incentive
Greater than or equal to 25 gallons but less than 35 gallons	0.90	0.70	$20
Greater than or equal to 35 gallons but less than 45 gallons	0.90	0.70	
Greater than or equal to 45 gallons but less than 55 gallons	0.90	0.70	
Greater than or equal to 55 gallons but less than 75 gallons	0.87	0.68	
Greater than or equal to 75 gallons but less than 100 gallons	0.87	0.68	
Greater than or equal to 100 gallons but less than 120 gallons	0.86	0.68	

2.2.1.11 Standby Generator Block Heater

This program provides an incentive to Avista's nonresidential electric customers (Schedule 11, 12, 21, 25) for the purchase and installation of a more efficient style of engine block heater. Traditional block heating technology employs a thermosiphon to drive circulation in an engine block. A more efficient option uses pump driven circulation and results in less wasted heat flow between the engine block and the ambient environment. This rebate is available for a retrofit only and requires pre-approval from Avista to do pre and post logging. The available incentive is $400 per heater.

Table 2-11: Fleet Heat Measures

Measure	Incentive
Standby Generator Block Heater	$400 / unit

2.2.2 Small Business

The Small-Medium Business (SMB) program is administered by SBW consulting and is a direct installation/audit program providing customer energy-efficiency opportunities by: (1) directly installing appropriate energy-saving measures at each target site, (2) conducting a brief onsite audit to identify customer opportunities and interest in existing Avista programs, and (3) providing materials and contact information so that customers are able to follow up with additional energy efficiency measures under existing programs. This program is only available to customers who receive electric service under Rate Schedule 11 in Washington and Idaho, and to customers who receive natural gas service under Rate Schedule 101 in Washington. Schedule 11 customers typically use less than 250,000 kWh per year.

Direct-install measures include faucet aerators, showerheads, pre-rinse spray valves, screw-in LEDs, smart strips, CoolerMisers, and VendingMisers (Table 2-12). The evaluation team conducted onsite verification, documentation audits, and engineering analysis to determine verified gross savings for each measure in the program.

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Table 2-12: Small Business Program Measure Overview

Category	Measure Description	Cost
Lighting	Screw in LED Lamp (40W Equivalent)	$17 /lamp
	Screw in LED Lamp (60W Equivalent)	$17 /lamp
	Screw in LED Lamp (100W Equivalent)	$31 /lamp
	Screw in LED BR30	$22 /lamp
	Screw in LED BR40	$28 /lamp
	Screw in LED PAR30	$28 /lamp
	Screw in LEDPAR38	$32 /lamp
Hot Water	Low-flow faucet aerator (0.5 gpm) Electric Water Heat	$8 /unit
	Low-flow faucet aerator (1.0 gpm) Electric Water Heat	$8 /unit
	Low-flow faucet aerator (0.5 gpm) Gas Water Heat	$8 /unit
	Low-flow faucet aerator (1.0 gpm) Gas Water Heat	$8 /unit
	Pre-Rinse Spray Valve Electric Heat	$129 /unit
	Pre-Rinse Spray Valve Gas Heat	$129 /unit
	Shower Head Fitness Electric	$41 /unit
	Shower Head Fitness Gas	$41 /unit
	Shower Head Electric	$41 /unit
	Shower Head Gas	$41 /unit
Cooler Miser	Control for glass-front cooler that uses passive infrared (PIR) sensor to power down machine when surrounding area is vacant	$225 /unit
Vending Miser	Control for refrigerated beverage machine that uses passive infrared (PIR) sensor to power down machine when surrounding area is vacant	$225 /unit
Tier 1 Smart Power Strip	Eliminate standby power draw of peripheral devices while continuing to power devices in "hot" outlets	$39 /unit

2.2.3 Residential

Avista's residential portfolio is composed of several approaches to engage and encourage customers to consider energy-efficiency improvements in their homes. Prescriptive rebate programs are the main component of the portfolio, together with a variety of other interventions. These include upstream buy-down of low-cost lighting and water-saving measures; select distribution of low-cost lighting and weatherization materials; an appliance recycling program; a low-interest loan program; direct-install programs; and a multi-faceted, multichannel outreach and customer engagement effort.

Throughout 2014 and 2015, Avista provided incentives and services for its residential electric and gas customers in its Idaho service territory and for residential electric customers throughout

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its Idaho service territory. The evaluation team examined nine core programs in Idaho that constituted the bulk of Avista's residential energy-efficiency offerings in 2014 and 2015. Table 2-13 provides a summary of those programs, and the sections below detail each program.

Table 2-13: Residential Program Type and Description

Type	Programs	Implementer	Description
Rebate	Appliance Recycling	JACO	Rebate for recycling fridge or freezer older than 1995. This program was discontinued in June 2015.
	ENERGY STAR® Homes	Avista	Rebate for purchase of ENERGY STAR® home
	Fuel Efficiency	Avista	Rebate for conversion of electric to natural gas furnace and/or water heater
	HVAC Program	Avista	Rebate for purchase of energy efficient and high efficiency HVAC equipment, including variable speed motors, air source heat pump, natural gas furnace and boiler, and smart thermostat
	Shell	Avista	Rebate for adding insulation to attic, walls, and floor, as well as adding energy efficient windows.
	Water Heater	Avista	Rebate for installation of high efficiency gas or electric water heater, natural gas water heater, and Smart Savings showerhead.
Midstream	Residential Lighting: Simple Steps, Smart Savings	CLEAResult	Direct manufacture discount for purchase of approved CFLs, LEDs (bulbs and fixtures), and low-flow showerheads.
Behavior	Home Energy Reports	Opower	The Opower program generates behavioral savings from a treatment group, which receives Home Energy Reports, which compares the customers energy usage to similar homes in Avista's service territory.
Low-income	Low-income Programs	Community Action Partners (CAPs)	CAPs within Avista's Washington and Idaho service territories implement the projects. CAPs determine energy-efficiency measure installations based on the results of a home energy audit.

2.2.3.1 Appliance Recycling

The appliance recycling program, administered by JACO Environmental Inc., provided a pick-up and recycling service for operational refrigerators or freezers manufactured before 1995. JACO provided the pick-up service free to customers and the $30 rebate was provided for each operational refrigerator and/or freezer, up to two per household (Table 2-14). JACO provided the following data points to Avista on a monthly basis: date of pick-up, customer name, address, city state zip, type of unit collected and number of units collected. The appliance recycling program ceased operation in June 2015 as a result of revised RTF values that became effective in July of 2015 causing the program to cease to be cost-effective.

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Table 2-14 Appliance Recycling Measures and Incentives

Measure	Rebate
Pre-1995 Freezer	$30
Pre-1995 Refrigerator	$30

2.2.3.2 HVAC Program

Avista internally manages the HVAC program which encourages the implementation of high efficiency HVAC equipment and smart thermostats through direct incentives issued to the customer after the measure has been installed (Table 2-15). This program is available to all residential electric or natural gas customers with a winter heating season usage of 4,000 or more kilowatt hours, or at least 160 therms of space heating the prior year. Existing or new construction homes are eligible.

Table 2-15 HVAC Measure Overview

Fuel Efficiency Measures	Rebate
Variable speed motor	$100
Electric to air source heat pump	$900
High efficiency natural gas furnace	$250
High efficiency natural gas boiler	$250
Smart thermostat	$50 or $100

2.2.3.3 Water Heat

Customers replacing their existing electric or natural gas water heater are eligible to receive a rebate for selecting a high efficiency option. This program also includes discounted showerheads available at participating retailers throughout Avista's WA and ID service territory under the Simple Steps, Smart Savings program. Table 2-16 outlines the measures offered and rebate per unit.

Table 2-16 Water Heat Program Measure Overview

Water Heat Measure	Rebate
Electric; 35-55 gallon with 0.94 EF or higher	$20
Natural Gas; 40 gallon with 0.62 EF or higher	$20
Natural Gas; 50 gallon with 0.60 EF or higher	$20
Natural Gas: Tankless with 0.82 EF or higher	$130
Simple Steps, Smart Savings Low-flow Showerheads: 1.5-2 GPM	buydown

2.2.3.4 ENERGY STAR® Homes

ENERGY STAR® certified home construction is administered by a Northwest Energy Efficiency Alliance (NEEA) regional program. Avista provides a rebate for homes within their service territory that successfully make it through this ENERGY STAR® certification process. In addition to NEEA's program, the manufactured homes industry has established a labeling program for Energy Star certified manufactured homes, which Avista also incentivizes. New home buyers

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can apply for an $800 rebate for an ENERGY STAR® ECO-rated new manufactured home or $1,000 for an ENERGY STAR® stick-built home. The purchaser must submit the application and certification paperwork to Avista within 90 days of occupying the residence. The ENERGY STAR® home rebate may not be combined with other Avista individual measure rebates (e.g. high efficiency water heaters).

Table 2-17 describes eligible measures available for the program.

Table 2-17 ENERGY STAR® Homes Measure Overview

Energy Star Home Measure	Rebate
Stick built – electric	$1,000
Stick built or manufactured w/ gas only	$650
Manufactured w/ furnace	$800
Manufactured w/ heat pump	$800

2.2.3.5 Fuel Efficiency Program

The fuel efficiency program offers a rebate for the conversion of electric straight resistance heat to natural gas, as well as the conversion of electric hot water heaters to natural gas models. The home must have used 4,000 or more kWh of electric space heat during the previous winter season to be eligible for flat-rate rebates. If natural gas is not available or is not suitable for the home, the installation of an air source heat pump as a replacement unit is accepted (see electric to air source heat pump measure under 2.2.3.2 HVAC Program.

Table 2-18 Fuel Efficiency Measure Overview

Fuel Efficiency Measures	Savings (kWh)	Rebate
Electric to natural gas conversion – space heat	12,012	$2,300
Electric to natural gas conversion – water heat	4,031	$600
Electric to natural furnace and water heat – combo	16,043	$3,200
Electric to natural gas wall heaters – space heat	10,932	$1,300

2.2.3.6 Residential Lighting

The Simple Steps, Smart Savings program provides discounts to manufacturers to lower the price of efficient light bulbs, light fixtures, showerheads, and appliances. This program, launched by Bonneville Power Administration (BPA) and administered by CLEAResult, operates across the Pacific Northwest. Utilities are able to select which reduced price items to include in their territory. Avista's offerings include a selection of general and special CFLs, LED light fixtures, and LED bulbs[2]. Retailers such a big box stores and regional and national chains are the primary recipient of the product and typically select from Avista's approved options what they will carry at their store location. These products are clearly identified with a sticker indicating they are part of the Simple Steps, Smart Savings program. Avista also encourages the use of

[2] Avista offered LED bulbs in 2014 and the last half of 2015.

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the LightRecycle CFL recycling locations throughout their Idaho service territory, to further support the utilization of CFL's.

2.2.3.7 Shell Program

Avista's internally managed shell program incentivizes measures that improve the integrity of the home's envelope (Table 2-19). For insulation and windows: rebates are issued to the customer after measure has been installed. Eligibility guidelines for participation include but may not be limited to: confirmation of electric or natural gas heating usage, itemized invoices including insulation levels or window values and square footage. Pre and/or post-inspection of insulation and windows may occur as necessary throughout the year. Customer must demonstrate a winter heating season electricity usage of 4,000 kilowatt hours or 160 therms to be eligible for insulation and window program participation. Addition of insulation that increases the R-value by R-10 or greater for both fitted/batt type and blow-in products are eligible. Windows with a U-factor of 0.30 or less that replace single or double pane windows are eligible.

Table 2-19 Shell Measure Overview

Fuel Efficiency Measures	Existing Equipment Efficiency	Rebate ($/sf)
Attic insulation	R-19 or less	$0.15
Wall insulation	R-5 or less	$0.25
Floor insulation	R-5 or less	$0.20
Window insulation	0.30 u-factor or lower	$4.00

2.2.3.8 Home Energy Reports

Avista provides peer comparison reports of home energy consumption, termed Home Energy Reports (HER), through Opower. This is an opt-out program aimed to encourage customers to save energy. 73,500 customers were initially mailed HERs in June of 2013: 48,300 to Washington customers and 25,200 to Idaho customers. The cadence of reports began by sending out a report every month for the first three months followed by a bi-monthly mailing of reports thereafter, continuing until June 2016. Customers must be a recipient of Avista electricity to qualify. Reports do not have a gas or dual fuel focus, though approximately 42% of recipients also have a gas meter.

2.2.3.9 Low Income

Avista leverages Community Action Program (CAP) agencies to deliver energy efficiency programs to low-income customers. CAP agencies have resources to income qualify, prioritize and treat homes based upon a number of characteristics. In addition to the Company's annual funding, the Agencies have other monetary resources that they can usually leverage when treating a home with weatherization and other energy efficiency measures. The Agencies either have in-house or contractor crews to install many of the efficiency measures of the program.

One CAP agency, Community Action Partnership – Lewiston, serves Avista's Idaho service territory. Avista provides the CAP agency with an "approved measure list", the items on this list

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are reimbursed 100% (Table 2-20). Avista also provides a "rebate list" of additional energy saving measures that the CAP agency can utilize (Table 2-21).

Table 2-20 Low Income Approved Measure List (100% of costs offset by Avista)

Measures
Electric to Gas Furnace Conversion
Electric to Gas Water Heater Conversion
Insulation (ceiling / attic, floors and walls)
Insulation (duct) / Duct sealing
Air Infiltration
Energy Star® Doors
Energy Star® Windows (gas heat)

Table 2-21 Low Income Rebate List

Measures
Electric to air source heat pump (when natural gas not viable)
Electric to natural gas water heater
Electric Water Heater (0.93 EF)
Gas Water Heater (0.62 EF)
Air Source Heat Pump
Gas Furnace (>90% AFUE)
Duct insulation (electric heat)
Duct insulation (gas heat)
Energy Star® Windows
Energy Star® Refrigerators
Energy Star® Windows (electric heat)

2.3 Program Participation Summary

Reported participation and savings for Avista's 2014 and 2015 programs is outlined in Table 2-22 and Table 2-23.

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Table 2-22 Avista Nonresidential Reported Participation and Savings

Program	2014-2015 Project Count	2014-2015 Reported Savings (kWh)
EnergySmart Grocer	149	2,387,662
Food Service Equipment	20	130,946
Green Motors	23	43,954
Motor Controls HVAC	4	466,340
Commercial Water Heaters	3	190
Prescriptive Lighting	327	3,475,049
Prescriptive Shell	9	54,381
Fleet Heat	3	7,228
Site Specific	125	5,813,610
Small Business	0	0
TOTAL	**663**	**12,379,360**

Table 2-23 Avista Residential Reported Participation and Savings

Program	2014-2015 Participation Count	2014-2015 Reported Savings (kWh)
Appliance Recycling	400	261,924
HVAC	599	872,828
Water Heat*	4,306	239,267
ENERGY STAR Homes	19	140,538
Fuel Efficiency	405	5,290,679
Lighting**	462,144	8,323,842
Shell	370	903,663
Opower***	19,366	2,746,000
Low Income****	7302	758,955
TOTAL	**494,911**	**19,537,696**

*Includes counts for both projects and showerheads
**Denotes bulb count and includes Simple Steps, and Giveaway
***Number of participants in the Treatment in January, 2015
****Includes both projects and counts of bulbs

2.4 Evaluation Goals and Objectives

"Model Energy-Efficiency Program Impact Evaluation Guide – A Resource of the National Action Plan for Energy Efficiency," published in November 2007. The report states:

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Evaluation is the process of determining and documenting the results, benefits, and lessons learned from an energy-efficiency program. Evaluation results can be used in planning future programs and determining the value and potential of a portfolio of energy-efficiency programs in an integrated resource planning process. It can also be used in retrospectively determining the performance (and resulting payments, incentives, or penalties) of contractors and administrators responsible for implementing efficiency programs.

Evaluation has two key objectives:

1. To document and measure the effects of a program and determine whether it met its goals with respect to being a reliable energy resource.

2. To help understand why those effects occurred and identify ways to improve.

Avista has identified the following objectives for the evaluation:

- Independently verify, measure and document energy savings impacts from Avista's electric and natural gas energy efficiency programs, or for program categories representing consolidated small scale program offerings, by Avista in 2014 and 2015
- Analytically substantiate the measurement of those savings
- Calculate the cost effectiveness of the portfolio and component programs
- Identify program improvements, if any,
- Identify possible future programs.

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3 Impact Evaluation Methodology

The impact evaluation evaluated the gross savings attributable to Avista's 2014 and 2015 energy-efficiency programs. Impact evaluations generally seek to quantify the energy and, when possible, the non-energy savings that have resulted from DSM program operations. These savings may be expressed as all of the changes resulting from the program (gross savings), or only those changes that would not have occurred absent the program (net savings).

The evaluation team verified the gross energy savings of Avista's 2014 and 2015 programs by:

- Understanding the program context
- Designing the impact evaluation sample
- Verifying the project and program savings through document review, telephone surveys, onsite measurement and verification, and billing analysis
- Comparing Avista-reported savings to savings verified during project-level evaluations to determine verified gross savings.

3.1 Understanding the Program Context

The first significant step of the evaluation activities was to gain a comprehensive understanding of the programs and measures being evaluated. Specifically, the team explored the following documents and data records:

- Avista's 2014 and 2015 Demand Side Management (DSM) Business Plans which detail processes and energy savings justifications
- Program tracking databases/spreadsheets and participation through December 2014
- Project documents from external sources, such as documents from customers, program consultants, or implementation contractors.

Based on the initial review, the evaluation team outlined the distribution of program contributions to the overall portfolio of programs. In addition, the review allowed the evaluation team to understand the sources for unit energy savings for each measure offered in the programs, along with the sources for energy-savings algorithms and the internal quality assurance and quality control (QA/QC) processes for large nonresidential projects. Following this review, the evaluation team designed the sample strategy for the impact evaluation activities, as discussed in the following section.

3.2 Designing the Sample

Sample development enabled the evaluation team to deliver meaningful, defensible results to Avista. The sampling methodology used for the impact evaluation was guided by a value of information (VOI) framework, which allowed the team to target activities and respondents with

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expected high impact and yield, while representing the entire population of interest. In general, VOI focuses budgets and rigor towards the programs/projects with high uncertainty and high impact[3].

For the sample design, the evaluation team organized the programs into evaluation "bins," segmenting the programs based on two metrics:

- **Program Uncertainty:** The risks associated with a program's reported savings were broken into three categories: high, medium, and low. Risks included custom vs. deemed vs. Regional Technical Forum status, delivery mechanism, performance goals, etc.
- **Program Size:** A determination of size—either large or small—was based on projected energy savings and planned budget allocations.

Bins were created for: (1) residential and nonresidential programs and (2) electric (Washington/Idaho) and natural gas (Washington) programs.

In parallel, the evaluation team calculated a "level of rigor" value for each program; based on assumed measure complexity and Regional Technical Forum (RTF) influence, the team identified an appropriate level of sampling and evaluation rigor.

- **Level of Sampling:** Defined as confidence/precision (C/P) for calculating sample sizes, the evaluation team used three levels for sampling: 90/10, 85/15, or 80/20 C/P.
- **Evaluation Rigor:** Defined as the level of detail used for the evaluation activities, the team identified four levels of increasing evaluation rigor: document audit, surveys, onsite inspections, and billing analysis. In many cases, a combination of these four approaches was used to both validate savings and provide insights into any identified discrepancies between reported and verified savings values.

The evaluation bin identified for each program was one factor in determining the sample size and level of rigor for the evaluation activities. Additional factors that influenced the sample size and level of rigor included evaluation costs, RTF influence, and findings and recommendations from previous evaluations.

Table 3-1 and Table 3-2 show the anticipated confidence/precision level, planned sample sizes, and level of rigor, by program, for the Washington/Idaho electric residential and nonresidential portfolios. The samples are drawn to meet the specified confidence/precision for each program and to meet 90% confidence and 10% precision at the portfolio level[4]. Because programs do not differ between the Washington and Idaho service territories, the sample approach was combined for both territories, and the findings from the impact evaluation (i.e. realization rates) were applied across both states.

[3] See Appendix A for detailed discussion on sampling and estimation.

[4] See Appendix A for detailed information on the presentation of uncertainty.

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Table 3-1: Planned Sampling and Evaluation Rigor for Washington/Idaho Electric Residential Programs

Electric Residential Program	Target C/P	Document Audit	Surveys	Onsite Inspections	Billing Analysis
Residential Appliance Recycling	90/10		70		
HVAC Program	90/10	67	67		
Water Heat Program[1]	80/20	11	11		
ENERGY STAR Homes	85/15	15	15		census
Fuel Efficiency	85/15	24	24		census
Residential Lighting Program[2]	90/10			70[3]	
Shell Program	85/15	24	24		census
Opower Behavioral Program	census				census
Low Income	85/15	24			census
TOTAL		**165**	**211**	**70**	

[1]Includes Simple Steps, Smart Savings upstream showerhead component
[2]Includes Simple Steps, Smart Savings upstream lighting program and CFL giveaway events
[3]Denotes sample size for residential lighting program logger study

Table 3-2: Sampling and Evaluation Rigor for Washington/Idaho Electric Nonresidential Programs

Electric Nonresidential Program	Target C/P	Document Audit	Surveys	Onsite Inspections	Billing Analysis
Prescriptive Lighting	90/10	68	16	16	
Prescriptive EnergySmart Grocer	95/15	44	15	15	
Prescriptive Non-Lighting Other	90/15	24	9	9	
Cascade Energy Pilot	80/20	5	5		
Site Specific	90/10	84	84	84	based on IPMVP[5]
Small Business	90/15	31	31	31	
TOTAL		**225**	**129**	**124**	

For the purposes of the evaluation sampling, the evaluation team has bundled the following nonresidential electric programs into one program titled "Prescriptive Non-Lighting":

-

[5] International Performance Measurement and Verification Protocol

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- Food Service Equipment
- Green Motors Rewind
- HVAC Variable Frequency Drive
- Clothes Washers
- Power Management for PC Networks
- Windows & Insulation
- Standby Generator Block Heater

Table 3-3: Achieved Sampling and Confidence/Precision for Washington/Idaho Electric Residential Programs

Electric Residential Program	Achieved C/P	Document Audit	Surveys	Onsite Inspections
Residential Appliance Recycling	N/A	70	72	
HVAC Program	90/31	68	68	
Water Heat Program[1]	90/13	24	13	
ENERGY STAR Homes	90/14	19	16	
Fuel Efficiency	90/7	26	25	
Residential Lighting Program[2]	90/15.3			75
Shell Program	90/33	28	28	
Opower Behavioral Program	90/8			
Low Income	90/13	24		
TOTAL	**90/9**	**259**	**222**	**75**

Table 3-4: Achieved Sampling and Evaluation Rigor for Washington/Idaho Electric Nonresidential Programs

Electric Nonresidential Program	Achieved C/P	Document Audit	Surveys	Onsite Inspections
Prescriptive Lighting	90/13	68	22	22
Prescriptive EnergySmart Grocer	95/14	44	20	20
Prescriptive Non-Lighting Other	90/228	24	15	15
Site Specific	90/7	101	84	84
TOTAL	**90/7**	**237**	**141**	**141**
Small Business	90/25	31		31
TOTAL INCLUDING SMALL BUSINESS:		**268**	**141**	**172**

3.3 Database Review

For the Small Business and Residential programs, the evaluation team conducted a review of the program databases as provided by Avista and its third-party implementers. The purpose of the review was to look for large outliers in program-reported data and to remove any duplicate

entries found in the databases. The outcome of the database review was an "adjusted reported" participation count and savings value for each measure and program. The realization rate that the evaluation team calculated as part of the gross verified savings activities, described in the following section, was then applied to the adjusted reported savings value.

3.4 Verifying the Sample – Gross Verified Savings

The next step in the impact evaluation process was to determine the gross impacts, which are the energy savings that are found at a customer site as the direct result of a program's operation; net impacts are the result of customer and market behavior that can add to or subtract from a program's direct results.

The impact evaluation activities resulted in realization rates, which were applied to the adjusted/ reported savings. The ratio of the savings determined from the site inspections, measurement and verification (M&V) activities, or engineering calculations to the program-reported savings was the project realization rate; the program realization rate was the weighted average for all projects in the sample. The savings obtained by multiplying the program realization rates by the program-adjusted/reported savings were termed the gross verified savings. These gross verified savings reflect the direct energy and demand impact of the program's operations.

Total program gross savings were adjusted using the following equation:

$$kWh_{adj} = kWh_{rep} \cdot Realization\ Rate$$

Where:

kWh_{adj}	=	kWh calculated by the evaluation team for the program, the gross impact
kWh_{rep}	=	kWh reported/adjusted for the program
Realization rate	=	weighted average kWh_{adj} / kWh_{rep} for the research sample

The estimate of gross verified energy savings occurred through one or more levels of evaluation rigor, as detailed in the following sections.

3.4.1 Document Audit

The first level of rigor that the evaluation team used was a document audit of all sampled projects for which documentation existed. Document audits were also a critical precursor for conducting telephone surveys and onsite inspections and, more specifically, for determining project-specific variables to be collected during these activities. The document audit for each sampled project sought to answer three questions:

- Were the data files of the sampled projects complete, well documented, and adequate for calculating and reporting the savings?

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- Were the calculation methods correctly applied, appropriate, and accurate?
- Were all the necessary fields properly populated?

3.4.2 Telephone Survey

A second level of evaluation rigor was through stand-alone telephone surveys with program participants. Telephone surveys were conducted in conjunction with the process evaluation activities and were used to gather information on the energy-efficiency measure implemented, the key parameters needed to verify the assumptions used by RTF for approved values or to estimate verified energy savings, and any baseline data that may be available from the participant.

3.4.3 Onsite Measurement and Verification

A sample of projects in the nonresidential sector was selected for onsite measurement and verification activities. Before conducting site inspections, it was important for field engineers to understand the project that they were verifying. This understanding built from the document-audit task discussed earlier. For all onsite inspections, a telephone survey served as an introduction to the evaluation activities and was used to confirm that the customer participated in the program, to confirm the appropriate contact, and to verify basic information such as building type and building size. All onsite activities were conducted by evaluation team field engineers.

The evaluation team conducted two levels of rigor associated with the onsite inspections – measurement and verification (M&V) and verification-only (V). Upon review of the project documents, the evaluation team decided which level of rigor was appropriate for each sampled project/measure. In cases where the measure had an approved RTF UES value, the evaluation team's effort focused on verifying the quality and quantity of installation to apply the RTF UES values to.

An M&V plan was developed for each M&V-designated project. The team based these plans on a review of the available calculation methods and assumptions used for determining measure-level energy savings. These plans aided in understanding what data to collect during onsite visits and telephone surveys to calculate gross verified savings for each sampled project.

M&V methods were developed with adherence to the IPMVP. As defined by IMPVP, the general equation for energy savings is defined as: [6]

Normalized Savings =

(Baseline Energy ± Routine Adjustments to fixed conditions ± Non-Routine Adjustments to fixed conditions) - (Reporting Period Energy ± Routine Adjustments to fixed conditions ± Non-Routine Adjustments to fixed conditions)

The broad categories of the IPMVP are as follows:

[6] Efficiency Valuation Organization (EVO) "International Performance Measurement and Verification Protocol (IMPVP) Concepts and Options for Determining Energy and Water Savings Volume 1", April 2007, page 19.

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- Option A, Retrofit Isolation: Key Parameter Measurement – This method uses engineering calculations, along with partial site measurements, to verify the savings resulting from specific measures.
- Option B, Retrofit Isolation: All Parameter Measurement – This method uses engineering calculations, along with ongoing site measurements, to verify the savings resulting from specific measures.
- Option C, Whole Facility: This method uses whole-facility energy usage information, most often focusing on a utility bill analysis, to evaluate savings.
- Option D, Calibrated Simulation: Computer energy models are employed to calculate savings as a function of the important independent variables. The models must include verified inputs that accurately characterize the project and must be calibrated to match actual energy usage.

In addition, the evaluation team conducted metering tasks on a subset of the onsite inspection sample chosen for the M&V level of rigor. Projects were selected for metering activities based on the measure type, project complexity, and the level of information needed to estimate gross savings for the project.

3.4.4 Billing Analysis

Participants received an assortment of efficiency measures through Avista's residential rebate programs. Billing analyses are generally considered a best practice for calculating energy savings resulting from "whole-house" efficiency retrofits. Thus, because of the diverse and interactive savings profiles associated with the improvements, the evaluation team determined that a utility bill regression analysis (IPMVP Option C) was the best method for quantifying energy savings resulting from the programs' treatment measures.

The utility billing analysis used data from participating customers who had sufficient utility-billed consumption records before and after the measure installation. Specifically, the evaluation team used a billing analysis approach for estimating gross verified savings for some or all measures in the following residential programs: Shell, Fuel Efficiency, HVAC, Opower, and Low Income. The remainder of this section outlines the general approach that the team followed for conducting the billing analysis. More specific details related to each program and measure evaluation are provided in Section 6.

The evaluation team requested program tracking data and complete billing histories for Avista's residential rebate program participants. IPMVP Option C utility bill analysis works best when at least one full year of utility billing data before and after the measure installation are available for comparison. This ensures that seasonal effects of the improvements are captured in the savings estimates. However, because of the timing of measure installations and the nature of certain programs, some customers had a limited amount of pre-retrofit and/or post-retrofit billing data. For example, accounts under the ENERGY STAR® Homes program do not have any "pre" billing data and, as a result, alternative methods were applied.

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Before performing the analysis, utility billing records were assessed for quality and completeness. Duplicate observations were removed from the billing data. Billing periods of more than 35 days or less than 26 days were also excluded from the dataset because these observations are not representative of a typical billing cycle.

In addition to program participation records and customer billing histories, the evaluation team collected daily temperature records and normal weather conditions (TMY3) from three weather stations located in Avista's service territory. Observed temperature records were used to calculate the number of heating degree days (HDD) and cooling degree days (CDD) in each customer's monthly billing period. Weather stations used by the evaluation team include Coeur d'Alene, Idaho; Lewiston, Idaho; and Spokane, Washington. Each participant was matched to the nearest weather station based on service address.

Gross verified energy savings were calculated by comparing billed consumption in months prior to the measure installations to the billed consumption in months after the measure installations. For most programs the evaluation team required homes to have 12 months of pre-retrofit consumption and 12-months of post-retrofit consumption for inclusion in the billing analysis. In cases in which participation was limited, this requirement was relaxed to increase sample sizes, provided that the participating homes had data from the key seasons. For example, switching from electric heat to a natural gas furnace will produce the largest savings during winter months. Because of the March 2016 timing of billing data collection, homes who implemented the fuel conversion measure in the summer of 2015 might have a full 12 months of pre-retrofit data but only 6 to 8 months of post-retrofit data. However, the post-retrofit period included the heating season and gave the regression model sufficient data upon which to establish a mathematical relationship between weather and consumption.

Table 3-5 defines the terms and coefficients shown in the two equations that follow. Equation 3-1 shows the general regression model specification used for electric measures, Equation 3-2 shows the general model specification used for gas measures. The key difference between them is the absence of cooling degree day (CDD) terms in the gas model. Because residential gas consumption is predominantly associated with heating, the evaluation team opted to exclude the CDD terms from the gas model, resulting in more robust impact estimates.

Equation 3-1: Regression Model Specification for Electric Measures

$$\mathrm{kWh}_{it} = \beta_i + \beta_1 \times \mathrm{Post}_{it} + \beta_2 \times \mathrm{CDD}_{it} + \beta_3(\mathrm{Post} \times \mathrm{CDD})_{it} + \beta_4 \times \mathrm{HDD}_{it} + \beta_5(\mathrm{Post} \times \mathrm{HDD})_{it} + \epsilon_{it}$$

Equation 3-2: Regression Model Specification for Gas Measures

$$\mathrm{Therms}_{it} = \beta_i + \beta_1 \times \mathrm{Post}_{it} + \beta_2 \times \mathrm{HDD}_{it} + \beta_3(\mathrm{Post} \times \mathrm{HDD})_{it} + \epsilon_{it}$$

Table 3-5: Fixed Effects Regression Model Definition of Terms

Variable	Definition
kWh_{it} / $Therms_{it}$	Estimated consumption in home i during period t (dependent variable)
$Post_{it}$	Indicator variable denoting pre-installation period vs. post-installation period
CDD_{it}	Average cooling degree days during period t at home i
HDD_{it}	Average heating degree days during period t at home i
β_i	Customer specific model intercept representing baseline consumption
β_{1-5}	Coefficients determined via regression describing impacts associated with independent variables
ϵ_{it}	Customer-level random error

The model specifications shown in Equation 3-1 and Equation 3-2 were used to determine the coefficients describing the relationship between consumption and weather. That relationship was then applied to normal weather conditions to estimate average annual consumption in the pre-installation and post-installation periods to calculate weather normalized savings.

The evaluation team used a multi-faceted approach to estimate savings for many of Avista's programs. The evaluation team used the fixed-effects regression models summarized above, together with a pooled approach, which combined all participants and billing periods into a single regression analysis to estimate weather normalized savings at the program or measure level. In some cases, the team then ran individual customer regressions to obtain weather normalized savings estimates for each customer, allowing for a more granular assessment of how savings magnitudes were distributed across the program or measure population. In addition, for measures with relatively small impact estimates, we included a control group constructed from homes in the Opower program, to achieve a more stable baseline comparison. For these measures, estimates were based on a difference-in-differences regression analysis of billing data from customers in the treatment and comparison groups.

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4 Nonresidential Impact Evaluation

This section outlines the impact evaluation methodology and findings for each of the evaluated nonresidential programs.

4.1 Overview

Avista offered 14 nonresidential programs in their Idaho service territory in 2014 and 2015. The reported savings for the nonresidential programs are summarized in Table 4-1.

Table 4-1: Nonresidential Program Reported Savings

Idaho Electric Nonresidential Program	2014-2015 Reported Savings (kWh)
EnergySmart Grocer	2,387,662
Food Service Equipment	130,946
Green Motors	43,954
Motor Controls HVAC	466,340
Commercial Water Heaters	190
Commercial Clothes Washers	--
Prescriptive Lighting	3,475,049
Power Mgmt for PC Networks	--
Prescriptive Shell	54,381
Fleet Heat	7,228
AirGuardian	--
Site Specific	5,813,610
Cascade Strategic Energy Management	--
Small Business	--
TOTAL NONRESIDENTIAL	**12,379,360**

No participation was reported in five programs: Commercial Clothes Washers, Power Management for PC Networks, AirGuardian, Cascade Strategic Energy Management, and Small Business. The Site Specific program contributes the largest share of the reported savings, 47% as shown in Figure 4-1. Prescriptive Lighting is the next largest contributor at 28%.

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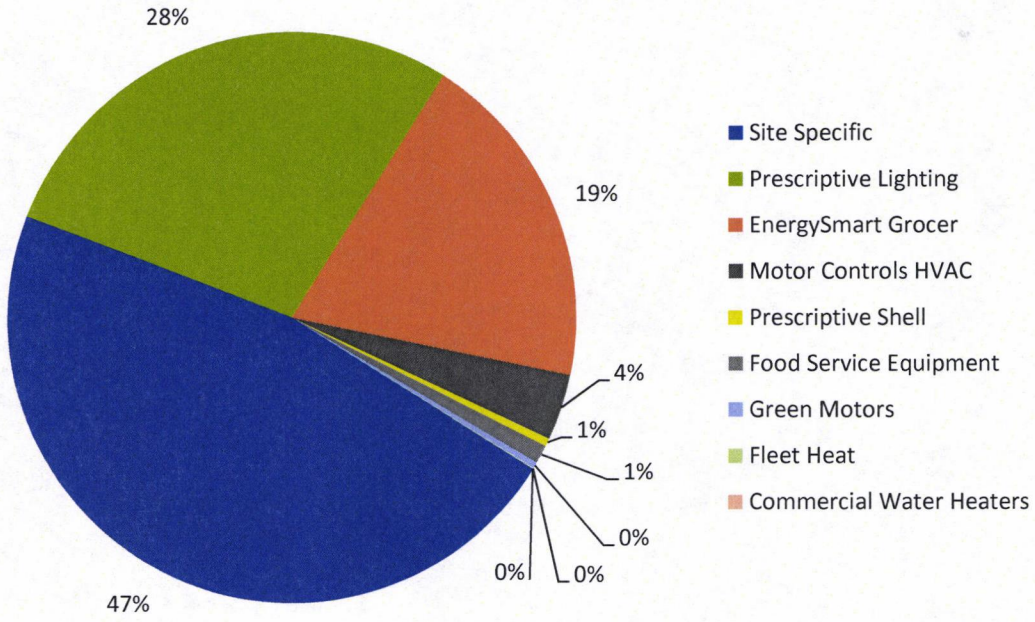
Figure 4-1: Nonresidential Program Reported Energy Savings Shares



The evaluation team designed a sampling strategy for these programs placing the most emphasis on the Site Specific program because of its large share of savings. The Site Specific program was divided into two strata based on reported savings. As part of the evaluation activities, a total of 237 document audits were conducted, and onsite inspections were conducted on a sub-sample of 141 projects, as shown in Table 4-2. Engineering activities included review of savings calculation methodology and assumptions, verification of operating hours through participant surveys and included use of data loggers in some cases, utility bill analysis, review of energy management system trend data, and energy savings analysis.

Table 4-2: Nonresidential Program Achieved Evaluation Sample

Program/Group	Achieved C/P	Document Audit	Survey	OnSite Inspections
Prescriptive Lighting	90/13	68	22	22
EnergySmart Grocer	90/14	44	20	20
Prescriptive Non-Lighting Other	90/228	24	15	15
Site Specific Large (> 275,000 kWh)	90/7	17	17	17
Site Specific Small (< 275,000 kWh)		84	67	67
TOTAL	**90/7**	**237**	**141**	**141**

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4.2 Prescriptive Lighting

4.2.1 Overview

The Prescriptive Lighting program encourages commercial customers and vendors to make lighting improvements to their businesses. The program provides many common retrofits to receive a pre-determined incentive based on baseline and replacement lamp wattages. The program is internally implemented by Avista.

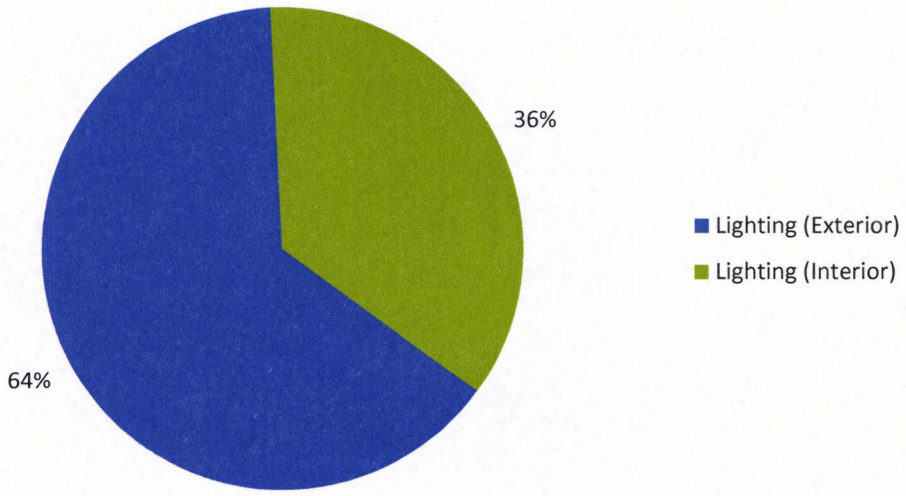
4.2.2 Program Achievements and Participation Summary

A total of 327 prescriptive lighting projects at 236 unique premises were installed in Idaho across the 2014 and 2015 program years. Table 4-3 and Figure 4-2 summarize Avista's 2014-2015 Prescriptive Lighting Program energy impacts by measure.

Table 4-3: Prescriptive Lighting Reported Energy Savings by Measure

Measure Type	Energy Savings (kWh)	% Electric Savings
Lighting (Exterior)	2,230,603	64%
Lighting (Interior)	1,244,446	36%
TOTAL	**3,475,049**	**100%**

Figure 4-2: Prescriptive Lighting Reported Energy Savings Shares



4.2.3 Methodology

The impact evaluation for this program followed the RTF's Nonresidential Lighting Retrofit Standard Protocol, IPMVP Option A (Retrofit Isolation: Key Parameter Measurement), and DOE

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Uniform Methods Commercial and Industrial Lighting Evaluation Protocol[7]. Engineering activities included installation verification, determination of operational hours including spot-metering in for a sub-sample of projects, and engineering savings calculations.

4.2.3.1 Sampling

The evaluation team conducted document audits for 68 projects. Customer surveys and onsite inspections were completed on a sub-sample of 22 of these projects (Table 4-4). Because of the installation of multiple projects at some sites, the achieved sample size for onsite inspections and surveys was slightly higher than the original sample design of 16 surveys and onsite inspections as noted in Table 3-2.

Table 4-4: Prescriptive Lighting Achieved Sample

Program	Document Audit	Survey	OnSite Inspections
Prescriptive Lighting	68	22	22

4.2.3.2 Document Audits

Project documentation was requested for each sampled project, including invoices, savings calculations, work order forms, equipment specification sheets, and any other project records that may exist. Thorough review of this documentation was the first crucial step in evaluation of each project.

4.2.3.3 Field Inspections

The telephone surveys conducted as part of the process evaluation were used to recruit projects for onsite inspection. These onsite inspections provide a more rigorous way to verify energy savings, and allowed the evaluation team to note any discrepancies between onsite findings regarding actual measure and equipment performance and the information gathered through the telephone surveys and project documentation. A survey instrument specific to this program was created in advance of the site inspections to ensure that the correct information was gathered.

Table 4-5 summarizes the information that was collected for each project during the onsite inspection. All parameters needed to support the savings analysis of a project were collected, including fixture counts, baseline and post-retrofit wattages, hours of operation, and HVAC system information (to inform calculation of interactive effects).

[7] http://energy.gov/sites/prod/files/2013/11/f5/53827-2.pdf

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Table 4-5: Prescriptive Lighting Onsite Data Collection

End Use Category	Baseline	Retrofit
All Facilities	Year facility was built Number of occupants Number of stories Business Type Operating Hours, posted or otherwise Total conditioned square footage Heating system type/age/efficiency/size/condition Cooling system type/age/efficiency/size/condition	
Lighting	Lamp Type (e.g., T8, T12) Ballast Type (mag. or elec.) Lamp Size (4 ft. or 8 ft.) Quantity of Lamps per Fixture Wattage per Lamp Fixture Quantity Operating Hours Control Type	Lamp Type Confirm Electronic Ballast and Factor Lamp Size Quantity of Lamps per Fixture Wattage per Lamp Fixture Quantity Operating Hours Control Type Confirm ENERGY STAR© rating

Where feasible and appropriate, the evaluation team also used standalone data loggers to minimize uncertainty in the estimation of lighting operating hours. Evaluation team engineers installed HOBO® U9-002 light on/off loggers for a minimum of four months. This collected measured data was supplemented by lighting operating characterization as determined through onsite interviews and surveys of control strategies (dimmers, timers, etc.) to inform the balance of the yearly operating hours.

The data collected over the logging duration was tabulated per hour per week to create an average weekly operation schedule for each measured space with energy efficiency measures. The weekly hourly profile includes 24 hours of each of eight distinct day types (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and holiday). Annual operating hours were created by extrapolating measured values to a calendar year, adjusted as needed per the interviews with onsite personnel.

4.2.3.4 Impact Analysis Methods

To calculate the gross verified energy savings of a lighting retrofit, the evaluation utilized the calculation outlined in Equation 4-1:

Equation 4-1: Prescriptive Lighting Energy Savings Calculation

$$\Delta kWh = \left(\#\ fixtures_{base} * kW_{base} - \#\ fixtures_{retrofit} * kW_{retrofit}\right) * Hours * IF$$

Where:

$\#\ fixtures_{base\ or\ retrofit}$ = Quantity of fixtures installed in baseline or retrofit of a project

Hours = Annual hours of fixture operation

IF = the ratio of heating and cooling electricity reduction per unit of lighting energy reduction resulting from the reduction in lighting waste heat removed by an electric HVAC system

Equation 4-1 is based on per fixture energy savings as calculated in Equation 4-2 and Equation 4-3:

Equation 4-2: Prescriptive Lighting Base Case Demand Savings Calculation

$$kW_{base} = \frac{\#\ lamps_{base} * Watts_{base} * BF_{base}}{1000}$$

Equation 4-3: Prescriptive Retrofit Case Demand Savings Calculation

$$kW_{retrofit} = \frac{\#\ lamps_{retrofit} * Watts_{retrofit} * BF_{retrofit}}{1000}$$

Where:

$\#\ lamps_{base\ or\ retrofit}$ = Quantity of lamps installed in a baseline or retrofit fixture

$Watts_{base\ or\ retrofit}$ = Wattage of baseline or retrofit lamp

$BF_{base\ or\ retrofit}$ = Ballast factor of baseline or retrofit light fixture

The analysis utilized a T8 baseline for linear fluorescent replacements, since T12 lamps are no longer compliant under federal regulations (EISA 2007 and EPact 2005).

Interactive Equipment Energy Changes for Lighting Retrofits

The energy consumption of lighting equipment within an enclosed space is not viewed in isolation. Building systems interact with one another and a change in one system will often affect the energy consumption of another. This interaction is important to consider when calculating the benefits provided by lighting equipment because it adopts a comprehensive view of premise-level energy changes rather than limiting the analysis to the energy change directly related to the modified equipment. The evaluation team utilized the interactive factors designated in the RTF's Non-residential Lighting Retrofits protocol[8] and included in Appendix B. Engineers gathered heating and cooling system types serving each space affected by a lighting retrofit project during the site visit in order to appropriately apply the RTF's factors. For desk reviews without an accompanying site visit, the evaluation team assumed electric cooling with gas heating in absence of better information.

[8] http://rtf.nwcouncil.org/measures/measure.asp?id=213

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4.2.4 Findings and Recommendations

The data collected as a result of the desk reviews and onsite data measurement and verification activities were utilized to estimate the gross verified savings. The evaluation team's gross verified savings values for the sample of reviewed projects were very close to Avista's reported values, resulting in realization rates near 100% for both measures. Individual project realization rates varied both above and below 100% due to differences in operating hours, baseline and retrofit fixture wattage, and application of interactive effects; these differences averaged out to realization rates near 100%. Table 4-6 summarizes the findings of the realization rate for energy benefits for each measure in the Prescriptive Lighting program.

Table 4-6: Prescriptive Lighting Realization Rate Results

Measure	Sample Unique Projects	Realization Rate	Relative Precision (90% Confidence)
Lighting (Exterior)	36	104%	N/A
Lighting (Interior)	32	97%	
TOTAL	**68**	**99%**	**13%**

The baseline fixture types for the projects in the evaluated sample for Interior Lighting are summarized in Table 4-7. Projects with multiple fixture types are counted multiple times. The majority of evaluated projects were retrofits of incandescent and HID technologies. Linear fluorescent participation was low, only 4 projects in the evaluation sample.

Table 4-7: Baseline Fixture Types for Prescriptive Lighting (Interior)

Baseline Fixture Type	Project Count
T8	1[1]
T12[2]	3
HID	11
Incandescent	21
Halogen	2
Sensor only project	1

[1]Baseline fixture type may have been T12. Project documentation does not specify. All T12s are analyzes using an analogous T8 baseline.

[2]Both Avista and the evaluation team estimated savings for these projects using the analogous T8 technology as the baseline.

Table 4-8 shows the total gross verified savings for the Prescriptive Lighting program.

Table 4-8: Prescriptive Lighting Gross Verified Savings

Program	Reported Savings (kWh)	Energy Realization Rate	Gross Verified Savings (kWh)
Prescriptive Lighting	3,475,049	99%	3,432,865

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4.3 Prescriptive EnergySmart Grocer

4.3.1 Overview

The EnergySmart Grocer program, implemented by CLEAResult, offers a range of proven energy-saving solutions for grocery stores and other customers with commercial refrigeration. This program is intended to prompt the customer to increase the energy efficiency of their refrigerated cases and related grocery equipment through direct financial incentives. Energy savings are primarily achieved through installation of high efficiency case lighting and other refrigeration system efficiency improvements. Some custom projects identified by CLEAResult are also included in the EnergySmart Grocer program.

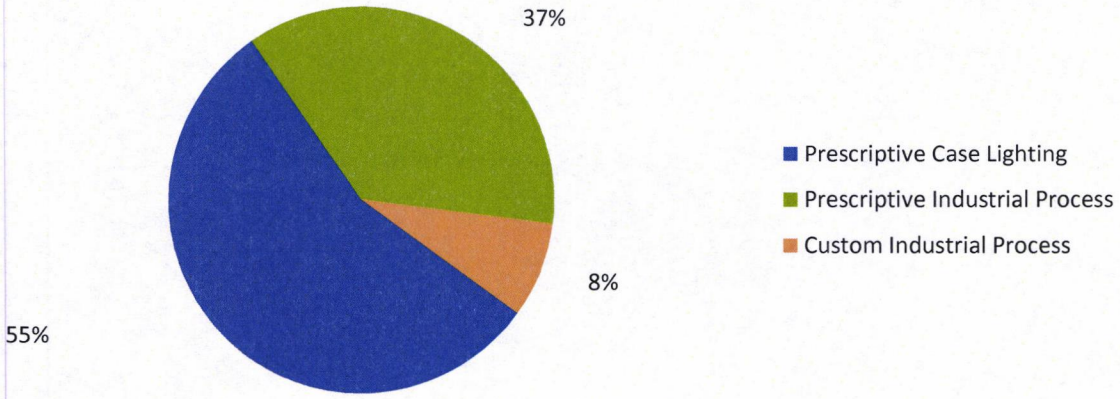
4.3.2 Program Achievements and Participation Summary

A total of 149 unique Prescriptive EnergySmart Grocer measures were installed at 68premises in Idaho in 2014 and 2015. Table 4-9 and Figure 4-3 summarize Avista's 2014-2015 EnergySmart Grocer Program energy impacts by measure. Avista tracks all non-Case Lighting measures as 'Industrial Process', both prescriptive and custom. Examples include ECMs in display cases, floating head pressure controls, etc.

Table 4-9: EnergySmart Grocer Reported Energy Savings by Measure

Measure Type	Energy Savings (kWh)	% Electric Savings
Prescriptive Case Lighting	1,322,341	55%
Prescriptive Industrial Process	873,852	37%
Custom Industrial Process	191,470	8%
TOTAL	**2,387,662**	**100%**

Figure 4-3: EnergySmart Grocer Reported Energy Savings Shares



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4.3.3 Methodology

Engineering activities for the evaluation of this program included review of project documentation, review of relevant RTF deemed savings values and workbooks, installation verification, determination of operational hours, and savings calculations.

4.3.3.1 Sampling Approach

The evaluation team conducted document audits on 44 projects implemented through the EnergySmart Grocer program. Surveys and onsite inspections were conducted for a sub-sample of 20 of these projects (Table 4-10). Because of the installation of multiple projects at some sites, the achieved sample size for onsite inspections and surveys was slightly higher than the original sample design of 15 surveys and onsite inspections as noted in Table 3-2.

Table 4-10: EnergySmart Grocer Achieved Sample

Program	Document Audit	Survey	OnSite Inspections
EnergySmart Grocer	44	20	20

4.3.3.2 Document Audits

Project documentation was requested for each sampled project, including invoices, savings calculations, work order forms, equipment specification sheets, and any other project records that may exist. Thorough review of this documentation was the first crucial step in evaluation of each project.

4.3.3.3 Field Inspections

The telephone surveys conducted as part of the process evaluation were used to recruit projects for onsite inspection verification. These onsite inspections provide a more rigorous way to verify energy savings, and allowed the evaluation team to note any discrepancies between onsite findings regarding actual measure and equipment performance and the information gathered through the telephone surveys and project documentation review. A survey instrument specific to this program was created in advance of the site inspections to ensure that the correct information was gathered.

Table 4-11 summarizes the information that was collected for each project during the onsite inspection. All parameters needed to support the savings analysis of a project were collected, including fixture counts, baseline and post-retrofit wattages, hours of operation, and HVAC system information to inform calculation of interactive effects.

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Table 4-11: EnergySmart Grocer Onsite Data Collection

End Use Category	Baseline	Retrofit
All Facilities	Business Type Operating Hours, posted or otherwise Total conditioned square footage Heating system type/age/efficiency/size/condition Cooling system type/age/efficiency/size/condition	
Case Lighting	Case Temperature Lamp Type (e.g., T8, T12) Ballast Type (mag. or elec.) Lamp Size (linear ft.) Quantity of Lamps per Fixture Wattage per Lamp Fixture Quantity Operating Hours Control Type	Case Temperature Lamp Type Confirm Electronic Ballast and Factor Lamp Size (linear ft.) Quantity of Lamps per Fixture Wattage per Lamp Fixture Quantity Operating Hours Control Type Confirm ENERGY STAR© rating
Industrial Process	Type of Equipment (e.g., open reach-in refrigerated case, closed freezer) Operating Temperatures Capacity Efficiency Operating Hours Other Parameters (e.g., motor kW or hp, linear feet of gaskets, thickness of suction line insulation)	Type of Equipment Operating Temperatures Capacity Efficiency Operating Hours Other Parameters

4.3.3.4 Impact Analysis Methods

The evaluation team applied deemed energy savings values as published by the Regional Technical Forum (RTF) where appropriate. Custom analyses were generated for measures not listed with the RTF.

Active RTF-listed Measures

A majority of the measures installed under the EnergySmart Grocer program are active measures with deemed energy savings values published by the RTF. For these measures, the evaluation team reviewed the relevant RTF workbooks[9] and the reported measure savings, verifying eligibility and appropriate application of RTF savings values for each project in the sample.

[9] Grocery - Display Case LEDs (Open Cases) v1.0, 1.1, 1.2, and 1.3. Grocery - Display Case LEDs (Reach-In Cases) v2.0, 2.2, 3.0, 3.1, and 3.2. Grocery – ECMs for Display Cases v2.0, 2.1, 2.2, and 3.0. Grocery – ECMs for Walk-ins. V1.1, 1.2, 2.0, and 2.1. Grocery – Floating Heat Pressure Controls for Single Compressor Systems v1.0, 1.1, 1.2, and 1.3. Available from http://rtf.nwcouncil.org/measures/Default.asp.

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Non-RTF Measures

For measures not listed with the RTF, the evaluation team analyzed the energy savings using custom project-specific methods.

4.3.4 Findings and Recommendations

The data collected as a result of the desk reviews and onsite measurement and verification activities were utilized to estimate the gross verified energy savings for each sampled project. The gross verified savings values for the sample of projects resulted in a realization rate of 90% for the EnergySmart Grocer program (Table 4-12).

Table 4-12: EnergySmart Grocer Impact Energy Realization Rate Results

Program	Sample Unique Projects	Energy Realization Rate	Relative Precision (90% Confidence)
EnergySmart Grocer	44	90%	14%

In the following subsections, the evaluation team notes observed reasons for the gross verified values for this program.

Application of RTF Deemed Savings Values

The RTF's deemed savings values for specific measures are periodically reviewed and updated based on further research and input from RTF members. For each revision, the RTF publishes a new workbook, and the current workbook as well as all prior versions are available on the RTF website. In some cases, different deemed savings values were observed to be used in the program tracking database for the same measure. The different deemed savings values appear to have been taken from different versions of the RTF workbooks. The program implementer appears to be updating its internal measure savings assumptions within the same program year.

Onsite Inspection Case Lighting Findings

The evaluation team found inconsistencies between onsite conditions and the applied RTF deemed savings values in a few cases. Fewer linear feet of case lighting was noted in one project of the 12 case lighting projects visited. In three cases, it was observed that projects reported as occurring in low-temperature cases (i.e. freezers) were actually medium-temperature cases (i.e. refrigerators). Lighting retrofits in medium-temperature cases result in lower energy savings because there is less interactive effect with the case refrigeration system due to the higher temperature. Overall, these finds play a relatively small role in the program realization rate.

Custom Project Findings

Custom projects incentivized under this program have significantly larger reported savings on average than the prescriptive projects. The reported energy savings for custom projects were generally determined using eQuest energy simulation modeling. The evaluation team found discrepancies in the energy model for one large project – a big box retail store with

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overestimated sales floor lighting hours of operation. Because of the size of the project, this one finding is a primary driver in reducing the program realization rate to 90%. The evaluation team recommends tracking atypical custom projects such as this one through the Site Specific program. This would allow such larger projects access to the QA/QC processes consistent with the Site Specific program.

Table 4-13 presents the 2014-2015 gross verified savings for the EnergySmart Grocer program.

Table 4-13: EnergySmart Grocer Gross Verified Savings

Program	Reported Savings (kWh)	Energy Realization Rate	Gross Verified Savings (kWh)
EnergySmart Grocer	2,387,662	90%	2,138,035

4.4 Prescriptive Non-Lighting Other Programs

4.4.1 Overview

For evaluation purposes, the evaluation team analyzed several of Avista's smaller prescriptive electric programs together under a "Prescriptive Non-Lighting Other" category. Table 4-14 lists brief summaries of the programs included in this group. All are implemented internally by Avista except Green Motors, which is implemented by the Green Motors Initiative.

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Table 4-14: Prescriptive Non-Lighting Other Program Summaries

Electric Programs	Description
Food Service Equipment	This program offers incentives for commercial customers who purchase or replace food service equipment with Energy Star or higher equipment (prescriptive).
Green Motors	The Green Motors Initiative is to organize, identify, educate, and promote member motor service centers to commit to energy saving shop rewind practices, continuous energy improvement and motor driven system efficiency.
HVAC Motor Controls	This program is intended to prompt the customer to increase the energy efficiency of their fan or pump applications with variable frequency drives through direct financial incentives.
Commercial Clothes Washers	This program encourages nonresidential customers to improve the efficiency of their clothes washing equipment.
Power Management for PC Networks	This program is designed to encourage implementation of power management software in networked PC's to obtain energy efficiency.
Commercial Windows & Insulation	This program encourages nonresidential customers to improve the envelope of their building by adding insulation and replacing windows.
Commercial Water Heaters	This program encourages nonresidential customers to improve the efficiency of their water heating equipment.
Fleet Heat	Installation of technology that reduces standby losses of vehicle engine blocks by fleet operators by adding the ability to energize block heaters only when Outside Air Temperature drops below a temperature set-point and the engine mounted thermostat is calling for heat.

4.4.2 Program Achievements and Participation Study

A total of 62 unique measures were installed at 42 premises in Idaho through these "Prescriptive Non-Lighting Other" programs in 2014 and 2015. Table 4-15 and Figure 4-4 summarize Avista's 2014-2015 reported energy impacts by measure for these programs in Idaho.

Table 4-15: Prescriptive Non-Lighting Other Reported Energy Savings by Measure

Program	Energy Savings (kWh)	% Electric Savings
Com Water Heater	190	0%
Com Windows and Insulation	54,381	8%
Food Service Equipment	130,946	19%
Green Motors Rewind	43,954	6%
HVAC Motor Controls	466,340	66%
Standby Generator Block	7,228	1%
TOTAL	**703,039**	**100%**

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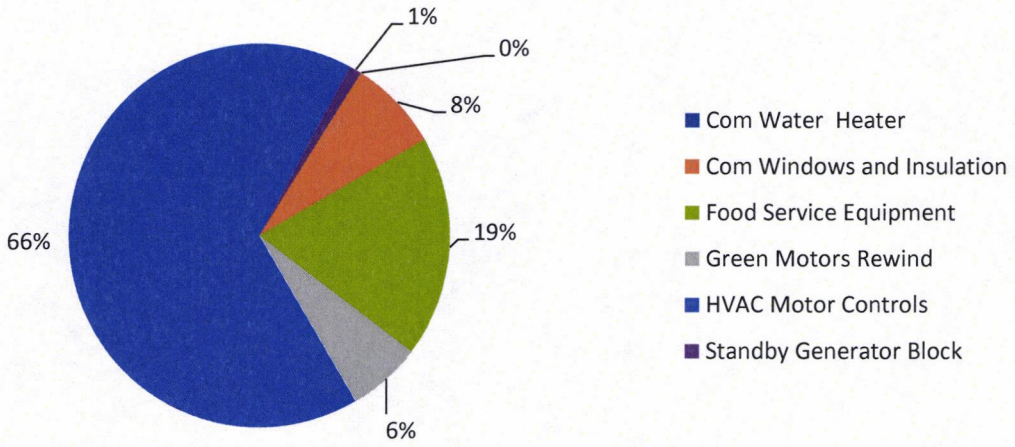
Figure 4-4: Prescriptive Non-Lighting Other Reported Energy Savings Shares



4.4.3 Methodology

Engineering activities for the evaluation of these projects varied by measure and included review of project documentation, review of relevant RTF deemed savings values and workbooks, installation verification, determination of operational hours, and savings calculations.

4.4.3.1 Sampling

The evaluation team conducted document audits for 24 projects that were grouped under the "Prescriptive Non-Lighting Other" category. Surveys and onsite inspections were conducted for a sub-sample of 15 of these projects (Table 4-16). Because of the installation of multiple projects at some sites, the achieved sample size for onsite inspections and surveys was slightly higher than the original sample design of 9 surveys and onsite inspections as noted in Table 3-2. The breakdown by program for the 24 document audits is provided in Table 4-17.

Table 4-16: Prescriptive Non-Lighting Other Achieved Sample

Program	Document Audit	Survey	OnSite Inspections
Prescriptive Non-Lighting Other	24	15	15

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Table 4-17: Prescriptive Non-Lighting Other Achieved Sample by Program

Measure	Sample Size
Commercial Water Heaters	0
Commercial Windows and Insulation	17
Food Service Equipment	2
Green Motors Rewind	1
Motor Controls HVAC	4
Fleet Heat	0

4.4.3.2 Document Audits

Project documentation was requested for each sampled project, including invoices, savings calculations, work order forms, equipment specification sheets, and any other project records that may exist. Thorough review of this documentation was the first crucial step in evaluation of each project.

4.4.3.3 Field Inspections

The telephone surveys conducted as part of the process evaluation were used to recruit a sample for onsite inspection verification. These onsite inspections provide a more rigorous way to verify energy savings, and allowed the evaluation team to note any discrepancies between onsite findings regarding actual measure and equipment performance and the information gathered through the telephone surveys and project documentation review. Because of the wide variety of measures included in this evaluation, site-specific survey instruments were generated in advance of each site inspections to ensure that sufficient information was gathered to support the analysis of each measure.

Table 4-18 summarizes the types of information that were collected for each project during the onsite inspection.

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Table 4-18: Prescriptive Non-Lighting Other Onsite Data Collection

End Use Category	Baseline	Retrofit
All Facilities	Year of construction Business Type Number of occupants Number of floors Operating Hours, posted or otherwise Total conditioned square footage	
HVAC	Type (e.g., DX, heat pump) Age Heating & Cooling Capacity Efficiency Operating Hours Operating Temperatures (space, supply, return, including info on setbacks) Control Capability / Strategy Other Features (e.g. economizer)	Type Age Capacity Efficiency Operating Hours Operating Temperatures Control Capability / Strategy Features
Motors	Motor size (hp) Motor Efficiency Age Condition Operating Hours	Motor size (hp) Motor Efficiency Age Condition Operating Hours VFD Speed (current settings and load profile)
Building Envelope	Insulation Type Insulation Thickness Window Type (no. of panes, type of glass)	Insulation Type Insulation Thickness Window Type (no. of panes, type of glass) Affected Window / Wall / Attic Area (sq ft)
Appliances		Manufacturer Model Number Efficiency

Onsite data collection for HVAC Motor Control (Variable Frequency Drive or VFD) measures included equipment inspection, interviews with site personnel, and collection of energy management system (EMS) trend data if available. Topics covered in the interview included:

- Fan operation prior to the installation of the VFD including baseline fan control capability:
  - On/Off
  - Inlet Guide Vanes
  - Discharge Damper
- Control programming associated with the VFD such as (1) facility operations schedule, (2) temperature setpoints, (3) differential pressure control

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- Minimum and maximum observed operating speeds and associated facility and weather conditions
- Typical operating speed
- Annual equipment operation schedule and variation on a daily, weekly, and annual basis
  - After-hours usage in evenings
  - Weekend usage
  - Summer shut down
  - Night setback
- Availability of trended VFD operating data via building EMS or other control system.

Field engineers gathered the following information from equipment nameplates or as-built drawings:

- Motor make and model
- Motor size (hp)
- Motor efficiency
- Motor speed (RPM)
- Motor type
- Fan type
- VFD make and model

Field engineers also collected operating parameters from the VFD drive's user interface control panel (if present). To facilitate this data collection, the field engineers were provided with model-specific guidance for accessing relevant parameters from the control panel. Although the availability of these operating parameters varies between different VFDs, common operating parameters collected include:

- Instantaneous operating parameters:
  - Frequency (Hz)
  - % speed
  - Motor power (W)
  - Motor amperage (A)
- Cumulative kWh and associated time interval

4.4.3.4 Impact Analysis Methods

Food Service Equipment

The Food Service Equipment projects included in the evaluation sample were for ENERGY STAR-rated ice makers. The evaluation team evaluated the energy savings of each ice maker using the Commercial Kitchen Equipment calculator published by ENERGY STAR[10]

[10] https://www.energystar.gov/sites/default/files/asset/document/commercial_kitchen_equipment_calculator%2003-15-2016.xlsx

Green Motor Rewinds

The energy savings for Green Motor Rewind projects were evaluated using the deemed savings values published by the RTF for this measure[11].

HVAC Motor Controls

The evaluation team assessed the HVAC Motor Control projects by modeling each affected motor's input power based on motor size, efficiency, and performance curves published by ASHRAE for various baseline motor control techniques (e.g. inlet guide vanes) as well as VFD control. The general form of the algorithm used presented in Equation 4-4.

Equation 4-4: HVAC Motor Controls Energy Savings Calculation

$$\Delta kWh = \sum_{cap=5\%}^{100\%} \left[kW_{baseline,cap} - kW_{efficient,cap}\right] \times hours_{cap}$$

Where:

Cap = operating capacity of the motor, ranging from 5% of full capacity to 100%

$kW_{baseline,cap}$ = Baseline motor power consumption at a specific capacity, based on ASHRAE performance curves for baseline motor control capability

$kW_{efficient,cap}$ = *Post-retrofit motor power consumption at a specific capacity, based on ASHRAE performance curve for VFDs*

$hours_{cap}$ = Number of annual hours operating at each % capacity

Commercial Windows and Insulation

For measures affecting building envelope (attic insulation, wall insulation, and window replacements), an industry-standard relationship for insulation improvements was applied. Energy savings during the cooling season were calculated using the algorithm in Equation 4-5

Equation 4-5: Commercial Windows and Insulation Cooling Savings Calculation

$$\Delta kWh_{cooling} = \frac{\left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right) \times Area \times 24 \times CDD}{1000 \times \eta_{cool}}$$

Where:

[11] http://rtf.nwcouncil.org/measures/measure.asp?id=115

$R_{pre\ and\ post}$ = *Pre- and Post-improvement R-values of insulation or windows*

A_{attic} = *Affected area (sq ft).*

CDD = *Annual cooling degree days*

η_{cool} = Cooling system efficiency, EER or SEER

For buildings with electric heat sources, including both electric resistance furnaces and heat pumps, the calculated savings during the heating season using the following algorithm (Equation 4-6):

Equation 4-6: Commercial Windows and Insulation Heating Savings Calculation

$$\Delta kWh_{heating} = \frac{\left(\frac{1}{R_{pre}} - \frac{1}{R_{post}}\right) \times Area \times 24 \times HDD}{\eta_{heat} \times 3412}$$

Where:

HDD = *Annual cooling degree days*

η_{heat} = Heating system efficiency

4.4.4 Findings and Recommendations

Table 4-19 presents the realization rate based on the gross verified savings values for the sample of reviewed projects in the Prescriptive Non-Lighting Other category

Table 4-19: Prescriptive Non-Lighting Other Realization Rate Results

Program/Category	Sample Unique Projects	Energy Realization Rate	Relative Precision (90% Confidence)
Prescriptive Non-Lighting Other	24	54%	228%

HVAC Motor Control Findings

The evaluation sample included four prescriptive HVAC Motor Control projects. Of these, a project for two VFDs was found to have a 50% project-level realization rate because the two VFDs were found to be serving a pair of motors operating in "Duty / Standby" configuration where only one of the two operates at a time. A second project for a single VFD was found to be installed in a non-typical VFD application (workshop dust collection system) and only being used as a soft-starter, with the motor continuing to operate at 100% speed during occupied hours and then switched off at night. Thus, this project was found to have zero energy savings. These findings are the major drivers in the low stratum-level realization rate as well as the high relative precision of 228% for this stratum. Without these two projects, the stratum's relative precision

improves to 20% at the 90% confidence interval.

To improve the realization rate, Avista should consider adding additional review processes to the program to check motor eligibility more stringently. More emphasis should be placed on verifying each motor's application, confirming the VFD is controlling the speed of the motor in a variable manner relative to load conditions, and checking that VFDs are not serving standby motors.

Food Service Equipment Findings

The evaluation team did not find any significant discrepancies in the evaluated sample of Food Service Equipment findings. Avista's reported energy savings are similar to what the evaluation team calculated using the ENERGY STAR calculator.

Green Motor Rewind Findings

The evaluation team found that Avista is appropriately applying the deemed values published by the RTF for Green Motor Rewind projects. No discrepancies were found.

Commercial Window and Insulation Findings

The algorithm the evaluation team utilized for verifying heating savings (both electric and gas) resulting from window replacements is very similar to what is used by Avista. Both algorithms estimate the effect of reduced thermal conduction loads on a building's heating system. For cooling savings, the program utilizes an algorithm that estimates savings based on reduced solar radiation loads. The evaluation team reviewed the SEEM model outputs included in the RTF's workbook for Small Commercial Weatherization for Avista's service territory and determined the program's radiation-based algorithm may be overstating savings. The evaluation team opted to apply only the conduction-based algorithm, similar to the heating savings algorithm, because the results aligned more closely with the SEEM values. Table 4-20 summarizes the program-reported and gross verified savings for window replacement cooling season savings, compared with SEEM results for Heating Zones 1 and 2.

Table 4-20: Cooling Season Savings for Window Replacements

	Cooling Season Savings (kWh/sqft)
Reported Savings	5.95
Gross Verified Savings	0.20
SEEM Results, Heating Zone 1*	-0.9 – 0.1
SEEM Results, Heating Zone 2*	0.02 – 0.68

*Values from Small Commercial Weatherization Workbook: SmallCommWx_ProCost_V2_0.xls

The evaluation team's algorithm resulted in very low realization rates for some projects, but the average savings for this type of project is small on average, so the overall impact on the program realization rate is minimal.

The evaluation team recommends that Avista consider alternate algorithms for the cooling

season or investigate other ways to support the program's current algorithm using energy modeling, billing analysis, or other third-party sources.

Table 4-21 shows the total gross verified savings for the programs evaluated under the "Prescriptive Non-Lighting Other" stratum.

Table 4-21: Prescriptive Non-Lighting Other Gross Verified Savings

Program	Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Com Water Heater	190	54%	103
Com Windows and Insulation	54,381		29,474
Food Service Equipment	130,946		70,971
Green Motors Rewind	43,954		23,823
HVAC Motor Controls	466,340		252,751
Standby Generator Block	7,228		3,917
TOTAL	**703,039**		**381,039**

4.5 Site Specific

4.5.1 Overview

Avista's Site Specific program offers commercial customers the opportunity to propose any energy efficiency project with documentable energy savings (kilowatt-hours and/or therms) for an incentive. The majority of projects in this program are appliance upgrades, compressed air, HVAC, industrial process, motors, shell measures, custom lighting projects, and natural gas multifamily market transformation. The Site Specific program is implemented internally by Avista, and program staff develop custom energy savings estimates for each project with input from the customer. Projects must have a simple payback period between one and eight years for lighting projects and between one and thirteen years for all other projects to be eligible for incentive.

4.5.2 Program Achievements and Participation Summary

A total of 125 unique measures were installed through the Site Specific program at 102 premises in Idaho throughout 2014 and 2015. Table 4-22 and Figure 4-5 summarize Avista's reported energy impacts by measure for the Site Specific program.

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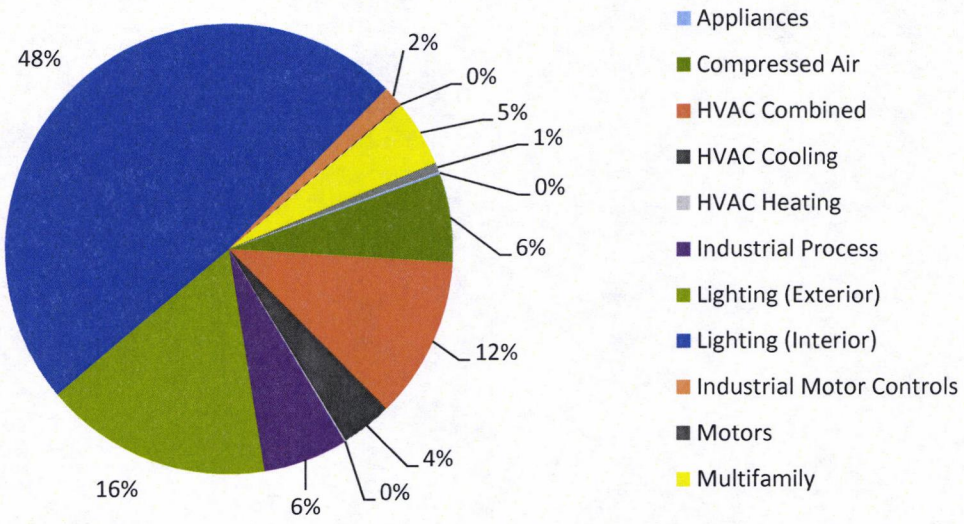
Table 4-22: Site Specific Reported Energy Savings by Measure

Measure Type	Energy Savings (kWh)	% Electric Savings
Appliances	8,237	0%
Compressed Air	369,035	6%
HVAC Combined	675,442	12%
HVAC Cooling	213,868	4%
HVAC Heating	5,557	0%
Industrial Process	354,318	6%
Lighting (Exterior)	957,055	16%
Lighting (Interior)	2,819,961	49%
Industrial Motor Controls	87,877	2%
Motors	5,351	0%
Multifamily	276,304	5%
Shell	40,605	1%
TOTAL	**5,813,610**	**100%**

Figure 4-5: Site Specific Reported Participation Energy Savings Shares



4.5.3 Methodology

The impact evaluation for this program followed IPMVP guidance as well as the DOE Uniform Method Protocol(s). The RTF's Non-Residential Lighting Retrofit Standard Protocol was followed for lighting projects and IPMVP Option C was used to guide billing analysis for select projects. Engineering activities included thorough review of the program savings methodology for each project, installation verification, determination of operational hours including spot-metering in some cases, collection of energy management system (EMS) trend data, and

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associated energy savings calculations.

4.5.3.1 Sampling

The evaluation team conducted 101 document audits on participating projects through the Site Specific program. Customer surveys and onsite inspections were conducted on a subset of these projects. Because of sample overlap with the Site Specific gas program, the achieved sample size for document audits was higher than planned. Within the Site Specific program, the evaluation team designated projects into two strata based on reported savings. Projects with a reported savings over 275,000 kWh were designated as Large projects, with all others designated as Small. This stratified sampling strategy was selected in order to ensure that the relative impacts of large projects were fairly represented in the program-level results. Table 4-23 outlines the achieved sample for the Site Specific Program.

Table 4-23: Site Specific Achieved Sample

Program Strata	Document Audit	Survey	OnSite Inspections
Large (> 275,000 kWh)	17	17	17
Small (< 275,000 kWh)	84	67	67
TOTAL	**101**	**84**	**84**

4.5.3.2 Document Audits

Project documentation was requested for each sampled project, including Avista's 'Top Sheets', invoices, savings calculations, work order forms, equipment specification sheets, and any other project records that may exist. The evaluation team's desk review process for Site Specific projects included tracking the history of each project through the various stages of the program as documented in the "Top Sheets". Thorough review of this documentation was the first crucial step in evaluation of each project.

For projects where Avista estimated savings using energy modeling software such as eQuest, the evaluation team requested and reviewed the energy models.

4.5.3.3 Field Inspections

The telephone surveys conducted as part of the process evaluation were primarily used to recruit a sample for onsite inspection verification. Some additional recruitment for this activity was done by phone separate from the process telephone survey.

The onsite inspections provide a more rigorous way to verify energy savings, and allowed the evaluation team to note any discrepancies between onsite findings regarding actual measure and equipment performance and the information gathered through the telephone surveys and project documentation review. Because of the wide variety of measures included in this evaluation, project-specific survey instruments were generated in advance of each onsite inspection to ensure that sufficient information was gathered to support the analysis of each

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measure.

Table 4-18 summarizes the types of information that were collected for each project during the onsite inspection. All parameters needed to support the savings analysis of a project were collected.

Table 4-24: Site Specific Onsite Data Collection

End Use Category	Baseline	Retrofit
All Facilities	Year of construction Business Type Number of occupants Number of floors Operating Hours, posted or otherwise Total conditioned square footage	
HVAC	Type (e.g., DX, heat pump) Age Heating & Cooling Capacity Efficiency Operating Hours Operating Temperatures (space, supply, return, including info on setbacks) Control Capability / Strategy Other Features (e.g. economizer)	Type Age Capacity Efficiency Operating Hours Operating Temperatures Control Capability / Strategy Features
Motors	Motor size (hp) Motor Efficiency Age Condition Operating Hours	Motor size (hp) Motor Efficiency Age Condition Operating Hours VFD Speed (current settings and load profile)
Building Envelope	Insulation Type Insulation Thickness Window Type (no. of panes, type of glass)	Insulation Type Insulation Thickness Window Type (no. of panes, type of glass) Affected Window / Wall / Attic Area (sq ft)
Appliances		Manufacturer Model Number Efficiency

Onsite data collection for HVAC Motor Control (Variable Frequency Drive or VFD) measures included equipment inspection, interviews with site personnel, and collection of energy management system (EMS) trend data if available. Topics covered in the interview included:

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- Fan operation prior to the installation of the VFD including baseline fan control capability:
  - On/Off
  - Inlet Guide Vanes
  - Discharge Damper
- Control programming associated with the VFD such as (1) facility operations schedule, (2) temperature setpoints, (3) differential pressure control
- Minimum and maximum observed operating speeds and associated facility and weather conditions
- Typical operating speed
- Annual equipment operation schedule and variation on a daily, weekly, and annual basis
  - After-hours usage in evenings
  - Weekend usage
  - Summer shut down.
  - Night setback
- Availability of trended VFD operating data via building EMS or other control system.

Field engineers gathered the following information from equipment nameplates or as-built drawings:

- Motor make and model
- Motor size (hp)
- Motor efficiency
- Motor speed (RPM)
- Motor type
- Fan type
- VFD make and model

Field engineers also collected operating parameters from the VFD drive's user interface control panel (if present). To facilitate this data collection, the field engineers were provided with model-specific guidance for accessing relevant parameters from the control panel. Although the availability of these operating parameters varies between different VFDs, common operating parameters collected include:

- Instantaneous operating parameters:
  - Frequency (Hz)
  - % speed
  - Motor power (W)
  - Motor amperage (A)
- Cumulative kWh and associated time interval

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4.5.3.4 Project-Specific Billing Analysis

The evaluation team reviewed utility bill histories for several projects where appropriate. To be a good candidate for savings estimation using utility bill analysis approach, a project must provide energy savings equal to at least 10% of the facility's annual consumption. Secondly, at least 9 months but preferably 12 months of post-project utility bill data must be available at the time of the analysis. Thirdly, conditions at the facility should be relatively static, except for the project of interest. The installation of other energy efficiency measures or other major changes at the facility makes billing analysis inappropriate for project-specific savings estimation. If a project was deemed to be a good candidate for utility bill analysis, then the evaluation team employed IPMVP Option C to estimate energy savings, normalizing for monthly variation in weather conditions.

4.5.3.5 Algorithm-Based Impact Analysis Methods

Because of the custom nature of the projects that participated in the Site Specific program, a wide array of custom analysis methods were utilized and tailored to each individual project. In many cases, if the evaluation team agreed with the program team's savings methodology, then the evaluation team used the same methodology for the project evaluation, updating only the input values and assumptions based on the results of onsite inspections or other data collection. In some cases, the evaluation team used a different methodology, especially where billing data or trend data allowed for savings to be calculated from measured data.

The evaluation team applied key algorithms for multiple projects, as described in the following sections.

Lighting Projects

The evaluation team utilized the same approach for the lighting projects as described in the methodology section for the Prescriptive Lighting Program (Section 4.2.3.4).

Variable Frequency Drives

Projects involving variable frequency drives (VFDs) were evaluated by modeling each affected motor's input power based on motor size, efficiency, and performance curves published by ASHRAE for various baseline motor control techniques (e.g. inlet guide vanes) as well as VFD control. The general form of the algorithm used is shown in

Equation 4-7:

Equation 4-7: VFD Energy Savings Calculation

$$\Delta kWh = \sum_{cap=5\%}^{100\%} \left[kW_{baseline,cap} - kW_{efficient,cap}\right] \times hours_{cap}$$

Where:

cap = operating capacity of the motor, ranging from 5% of full capacity to

100%

$kW_{baseline,cap}$ = Baseline motor power consumption at a specific capacity, based on ASHRAE performance curves for baseline motor control capability

$kW_{efficient,cap}$ = Post-retrofit motor power consumption at a specific capacity, based on ASHRAE performance curve for VFDs

$hours_{cap}$ = Number of annual hours operating at each % capacity

HVAC Replacements

For HVAC projects various permutations of Equation 4-8 were utilized to calculate savings, as applicable:

Equation 4-8: HVAC Replacement Energy Savings Calculation

$$\Delta kWh = EFLH \times kBtuH \times \left(\frac{1}{IEER_{base}} - \frac{1}{IEER_{ee}}\right)$$

Commercial Windows and Insulation

The evaluation team utilized the same approach for the commercial windows and insulation projects as described in the methodology section for the Prescriptive Non-Lighting Other Programs (Section 4.4.3.4)

4.5.4 Findings and Recommendations

The evaluation team found that the 2014-2015 Site Specific program achieved energy savings very close to its reported performance, with a program-level realization rate of 99% (Table 4-25). Although individual project realization rates within the evaluation team's sample vary both above and below 100%, the high overall average for the program of 99% reflects the high level of review and scrutiny that Avista places on the projects that participate in the Site Specific program.

Table 4-25: Site Specific Program Realization Rate Results

Strata	Sample Unique Projects	Energy Realization Rate	Relative Precision (90% Confidence)
Large (> 275,000 kWh)	17	96%	5%
Small (< 275,000 kWh)	84	101%	12%
TOTAL	**101**	**99%**	**7%**

Measure-level realization rates for measures where more than one project was included in the evaluation sample are presented in Table 4-26.

Table 4-26: Site Specific Measure-Level Gross Verified Savings

Measure	Sample Unique Projects	Energy Realization Rate
Appliances	3	100%
HVAC Combined	31	95%
Industrial Process	4	87%
Lighting (Exterior)	15	102%
Lighting (Interior)	38	112%
Multifamily	3	86%
Shell	5	35%

Lighting Project Findings

The review of lighting projects in the evaluation sample for the Site Specific program showed that Avista is generating high quality savings estimates for these projects, with measure-level realization rates of 102% for Exterior Lighting and 112% for Interior Lighting. The primary factor driving up the realization rate for Interior Lighting is the calculation of interactive effects. The program uses a 7.7% interactive factor for air conditioned spaces with gas heat, the most prevalent HVAC system type in the program, regardless of building type. The evaluation team applied the interactive factors listed by the RTF, which range from 94% to 116% for that HVAC system type (Appendix B). However many of the evaluated projects were in building types at the higher end of the RTF's range, such as Big Box Retail, Anchor Store Retail, and College/University.

The baseline fixture types for the projects in the evaluated sample are summarized in Table 4-27. Projects with multiple fixture types are counted multiple times. The evaluation team observed a distributed participation across several baseline fixture types in the sample.

Table 4-27: Baseline Fixture Types for Site Specific Interior Lighting

Baseline Fixture Type	Project Count
T8	9
T12*	7
T5	5
HID	8
Incandescent	3
CFL	1
New construction	1
Sensor only project	9

*Both Avista and the evaluation team estimated savings for these projects using the analogous T8 technology as the baseline.

Window and Insulation Findings

As similarly described for prescriptive window replacements in Section 4.4.3.4, the algorithm

applied for cooling season savings is more conservative than what Avista is using. The program utilizes an algorithm that estimates savings based on reduced solar radiation loads. The evaluation team reviewed the SEEM model outputs included in the RTF's workbook for Small Commercial Weatherization for Avista's service territory and determined the program's radiation-based algorithm may be overstating savings. We opted to apply only a conduction-based algorithm, similar to the heating savings algorithm, because the results aligned more closely with the SEEM values. This difference of approach is the primary driver in the 35% realization rate for Shell measures. However, since this measure makes up only 1% of the total program savings, the impact on the program realization rate is minimal.

Table 4-28 shows the total gross verified savings for the Site Specific program.

Table 4-28: Site Specific Gross Verified Savings

Program	2014-2015 Reported Savings (kWh)	Realization Rate	2014-2015 Gross Verified Savings (kWh)
Site Specific	5,813,610	99%	5,735,284

The high realization rate for this program indicates that Avista's internal process for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts. The evaluation team recommends that Avista continue to operate this program with the current level of rigor.

4.6 Nonresidential Sector Results Summary

Table 4-29 lists the gross verified savings for each of Avista's nonresidential programs in Idaho in 2014-2015. The Idaho electric nonresidential sector achieved a 94% realization rate and the relative precision of the program-level electric realization rate was ±7% at the 90% confidence level.

Table 4-29: Nonresidential Program Gross Impact Evaluation Results

Idaho Electric Nonresidential Program	2014-2015 Reported Savings (kWh)	Realization Rate	2014-2015 Verified Gross Savings (kWh)
EnergySmart Grocer	2,387,662	90%	2,138,035
Food Service Equipment	130,946	54%	70,971
Green Motors	43,954	54%	23,823
Motor Controls HVAC	466,340	54%	252,751
Commercial Water Heaters	190	54%	103
Prescriptive Lighting	3,475,049	99%	3,432,865
Prescriptive Shell	54,381	54%	29,474
Fleet Heat	7,228	54%	3,917
Site Specific	5,813,610	99%	5,735,284
NONRESIDENTIAL TOTAL	**12,379,360**	**94%**	**11,687,224**

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5 Small Business Impact Evaluation

5.1 Overview

The Small Business (SB) program is a third-party-administered (SBW Consulting), direct installation/audit program, providing customer energy efficiency opportunities by:

1) Directly installing appropriate energy-saving measures at each target site
2) Conducting a brief onsite audit to identify customer opportunities and interest in existing Avista programs
3) Providing materials and contact information so that customers are able to follow up with additional energy efficiency measures under existing programs.

Direct-install measures include:

- Faucet aerators
- Showerheads
- Pre-rinse spray valves
- Screw-in LEDs
- Smart power strips
- CoolerMisers
- VendingMisers

The evaluation team conducted onsite verification, documentation audits, and engineering analysis to determine verified gross savings for each measure in the program. Another key objective for this evaluation was to develop new deemed savings values for faucet aerators and pre-rinse spray valves based upon secondary research of statewide technical reference manuals (TRMs) and published third-party data.

5.2 Program Achievements and Participation Summary

There were no Small Business participants in the Idaho service territory in 2015. The evaluation team conducted impact evaluation activities on a sample of projects implemented in Avista's Washington service territory. The findings from the evaluation activities conducted in Washington are presented here and the evaluation team recommends that the findings be considered for future program planning in Avista's Idaho service territory.

5.2.1.1 Sampling

The evaluation team selected a simple random sample of 31 projects for the impact evaluation of the Small Business Program. Onsite verification was performed for all 31 sites. The 31 sampled project sites collectively accounted for a total of 191 electric and 46 natural gas saving measures. Table 5-1 summarizes the achieved sample size.

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Table 5-1: Small Business Program Impact Evaluation Achieved Sample

Program	On-Site Verification	Document Audit
Small Business	31	31

5.2.2 Document Audits

The evaluation team conducted a review of the project documentation for each sampled project, including invoices, savings calculations, work order forms, equipment specification sheets, and any other project records that may exist. Thorough review of this documentation was the first crucial step in evaluation of each project.

5.2.3 Onsite Inspections

The impact evaluation activities included telephone surveys, documentation audits, and onsite inspections for the entire sample. A telephone survey served as an introduction to the evaluation activities and was used to confirm that the customer participated in the program, confirm the appropriate contact, and to verify basic information such as building type and building size. Arrangements for onsite inspections were then made during the telephone survey.

The onsite inspections were used to determine whether:

- The measure tracking database correctly represented the work that was done at each site
- The measures remained installed and were operational
- There were any opportunities for measure installation that were missed
- There were assumptions embedded in the deemed savings estimates for each installed measure (e.g. 3,000 lighting hours of use) applicable to the site.

Field engineers were equipped with a custom field data collection tool designed to capture the relevant data points for each measure included in the SB program. Table 5-2 summarizes the information that was collected for each measure type during the onsite inspection. All parameters needed to support the savings analysis of a project were collected, including, but not limited to, fixture counts, hours of operation, and water heater fuel type.

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Table 5-2: Small Business Program Onsite Data Collection

Measure Type	Key Parameters
All Facilities	Number of occupants Business Type Operating Hours, posted or otherwise Water Heater Type (Tank or Tankless) Water Heater Fuel Type (Natural Gas or Electric)
Lighting	Quantity of Lamps Installed Quantity of Lamps Decommissioned Lighting Hours of Use Pre- and Post-retrofit Lamp Wattage
Faucet Aerators Pre-rinse Sprayers Showerheads	Quantity of Efficient Fixtures/Aerators Installed Quantity of Efficient Fixtures/Aerators Decommissioned Device Flow Rate Water Heater Type Facility Hot Water Load
VendingMiser CoolingMiser	Quantity Installed Quantity Decommissioned Vending Machine Type Occupancy Hours Frequency of Use
Tier 1 Smart Power Strips	Quantity Installed Quantity Decommissioned Connected Plug Loads Baseline Conditions

5.2.4 Impact Analysis Methods

The evaluation team estimated gross verified savings using the field verified quantities and the program-specified deemed savings value for each measure. The deemed savings values used by the program originate from a variety of sources including (UES) measures from the Regional Technical Forum (RTF), California DEER database[12], and Puget Sound Energy 2014-2015 unit energy savings values. Verified energy savings were generally calculated for each measure using Equation 5-1:

Equation 5-1: Small Business Program Energy Savings Calculation

$$\Delta kWh = Quantity\ Verified\ x\ kWh\ Saved/Unit$$

Where:

Quantity Verified = Quantity of devices/fixtures/lamps verified onsite

[12] http://www.deeresources.com/

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kWh Saved = Program-stipulated electric energy (kWh) saved per unit installed

In addition to estimating program-level savings, the evaluation team also conducted a deemed savings review for each direct-install measure offered by the Small Business Program. This review process consisted of comparing deemed savings values used by Avista with those used by similar programs in other jurisdictions and in other statewide TRMs. Recommended updates to the deemed savings values were developed by the evaluation team for the faucet aerator and pre-rinse spray valve measure offerings. The deemed savings assumptions used for the remainder of the measures were deemed appropriate and therefore, were not modified in the analysis. Additional details on the research conducted and measure-specific findings determined for faucet aerators and pre-rinse spray valves are discussed in the Findings and Recommendations section below.

5.3 Findings and Recommendations

The gross verified electric energy savings for the sample of reviewed projects for the Small Business program resulted in a realization rate of 102% (Table 5-3).

Table 5-3: Small Business Program Realization Rate Summary

Measure Category	Sampled Measures	Electric Energy Realization Rate	Relative Precision (90% Confidence)
Lighting	62	91%	
Faucet Aerators	59	126%	
Pre-rinse Sprayers	2	85%	
Showerheads	0	100%	
VendingMiser	9	100%	
CoolerMiser	18	95%	
Tier 1 Smart Power Strip	41	89%	
TOTAL	**191**	**102%**	**25%**

5.3.1.1 Deemed Savings for Faucet Aerators

The evaluation team developed new electric (kWh) and natural gas (therms) deemed savings values for both 0.5 GPM and 1.0 GPM faucet aerators installed through the program. The newly developed values were applied on a per device installed basis. They were developed based upon a comprehensive review of five statewide technical reference manuals[13], assumptions for similar measures offered in other jurisdictions[14], and assumptions from applicable RTF UES measures. During the research process, the evaluation team not only compiled the deemed energy savings values used by each source, but also some of the underlying assumptions such

[13] Statewide TRMs reviewed as part of our research included Massachusetts, Pennsylvania, Wisconsin, Minnesota, and Michigan.

[14] Programs from other jurisdictions included the ComEd Small Business Energy Savings (SBES) Program and a program offered by Questar Gas.

as baseline and efficient device flow rates (GPM), frequency of use, hot water temperature, and inlet water temperature. A summary of key findings and recommendations are provided in Table 5-4.

Table 5-4: Recommended Deemed Savings Values for Faucet Aerator Measures

Measure	Avg Base GPM	Avg Reduced GPM	Avg Gal Reduced/yr	Hot H2O Temp (°F)	Inlet H2O Temp (°F)	Avg Deemed kWh Savings	Avg Deemed therms Savings
Faucet Aerator (1.0)	2.1	1.2	5,460	105	52	176	12
Faucet Aerator (0.5)	2.1	0.5	4,500	105	52	300	21

5.3.1.2 Deemed Savings for Pre-Rinse Spray Valves

The evaluation team also developed verified per-device energy savings estimates for pre-rinse spray valves using the same approach and data sources described for faucet aerators. Key findings from this research are provided in Table 5-5.

Table 5-5: Recommended Deemed Savings Values for Pre-Rinse Spray Valve Measures

Measure	Avg Base GPM	Avg Reduced GPM	Avg Gal Reduced/yr	Hot H2O Temp (°F)	Inlet H2O Temp (°F)	Avg Deemed kWh Savings	Avg Deemed therms Savings
Pre-Rinse Sprayer	1.8	1.1	23,617	105	52	1,130	72

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6 Residential Impact Evaluation

The following sections outline the impact evaluation methodology and findings for each of the evaluated residential programs and the low income program.

6.1 Overview

Avista offered seven electric incentive-based residential programs, one residential behavioral program (Opower), and the low income program in their Idaho service territory in 2014 and 2015. The reported savings for these residential programs are summarized in Table 6-1.

Table 6-1: Residential Program Reported Savings

Idaho Electric Program	2014–2015 Reported Savings (kWh)
Appliance Recycling	261,924
HVAC	872,828
Water Heat	239,267
ENERGY STAR Homes	140,538
Fuel Efficiency	5,290,679
Lighting	8,323,842
Shell	903,663
Opower (Home Energy Reports)	2,746,000
Low Income	758,955
TOTAL PORTFOLIO	**19,537,696**

The Lighting program contributes the largest share of the reported savings, 43% as shown in Figure 6-1. Fuel Efficiency is the next largest contributor at 27%.

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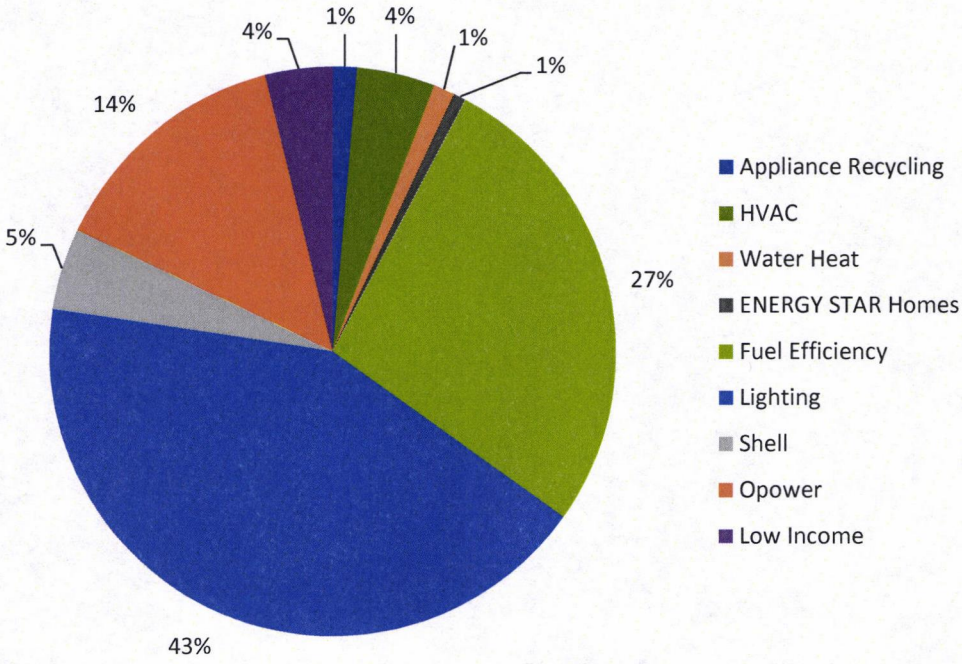
Figure 6-1: Residential Program Reported Energy Savings Shares



The evaluation team designed a sampling strategy for these programs placing the most emphasis on the programs with the highest projected savings and the highest level of uncertainty. As part of the evaluation activities, a total of 259 document audits and 222 telephone surveys were conducted, and onsite inspections were conducted on 75 homes in support of the Lighting Hours of Use study, as shown in Table 6-2. Engineering activities included review of savings calculation methodology and assumptions, utility bill analysis and energy savings analysis.

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Table 6-2: Residential Program Achieved Evaluation Sample

Electric Residential Program	Achieved C/P	Document Audit	Surveys	Onsite Inspections
Residential Appliance Recycling	N/A	70	72	
HVAC Program	90/31	68	68	
Water Heat Program	90/13	24	13	
ENERGY STAR Homes	90/14	19	16	
Fuel Efficiency	90/7	26	25	
Residential Lighting Program	90/15.3			75
Shell Program	90/33	28	28	
Opower Behavioral Program	90/8			
Low Income	90/13	24		
TOTAL	**90/9**	**259**	**222**	**75**

6.2 Residential Appliance Recycling

6.2.1 Overview

The appliance recycling program, administered by JACO Environmental Inc., provided a pick-up and recycling service for operational refrigerators or freezers manufactured before 1995. The pick-up service was free to customers and a $30 rebate was provided for each operational refrigerator and/or freezer, up to two per household. JACO provided the following data points to Avista on a monthly basis: date of pick-up, customer name, address, city state zip, type of unit collected and number of units collected. The appliance recycling program ceased operation in June 2015 as a result of revised RTF values that became effective in July of 2015 causing the program to cease to be cost-effective.

6.2.2 Program Achievements and Participation Summary

The Appliance Recycling Program's reported participation and savings across the 2014–2015 program cycle is presented in Table 6-3.

Table 6-3 Appliance Program Reported Participation and Savings

Measure	2014–2015 Reported Participation	2014–2015 Reported Savings (kWh)
Refrigerator	309	198,150
Freezer	91	63,774
TOTAL	**400**	**261,924**

6.2.3 Methodology

The evaluation team conducted telephone surveys and document audits for 72 program participants.

To record participation, Avista totals participation on a monthly basis from data provided directly by the implementer, JACO. JACO also provided the evaluation team with a total database of all units recycled in 2014 and 2015 under the Avista program. The evaluation team checked this database for duplicates (zero found), and cleaned the database of refrigerators and freezers collected that did not meet the program criteria of being manufactured before 1995 (125 records). The evaluation team then compared these results to Avista's reported values. The final cleaned database reported 1,288 appliances recycled in WA over 2014 and 2015 (Table 6-4).

Table 6-4 Appliance Recycling Participation Counts

Measure	Avista Reported Participation	Implementer Reported Participation	Adjusted Reported Participation
Refrigerators	309	526	306
Freezers	91	157	92
TOTAL	**400**	**683**	**398**

Avista's deemed savings values reported per recycled freezer and refrigerator are based on RTF unit energy savings which include the effects of freeridership. For purposes of estimating a gross savings value for the measures, the evaluation team reviewed the findings from the 2012-2013 Washington Impact Evaluation[15]. The evaluation team then applied the gross verified savings values reported in the prior evaluation study to the adjusted reported participation values identified by the evaluation team. Table 6-5 outlines the Avista reported and evaluated savings per unit for the Appliance Recycling program.

Table 6-5 Appliance Recycling Reported and Evaluated Savings

Measure	Avista Reported Savings Value (kWh/unit)	2012-2013 Evaluated Savings (kWh/unit)
Refrigerators	636	1,090
Freezers	612	902

6.2.4 Findings and Recommendations

While this program has been cancelled, there are a few findings that may assist Avista in planning purposes should they implement a similar program in the future.

- The implementer JACO provided each customer with an OrderID, and collects datapoints for reporting to Avista including: name, account number, address, the type

[15] Avista 2012-2013 Washington Electric Impact Evaluation Report, The Cadmus Group, Inc. May 15, 2014

unit recycled, make and model, as well as the year. Due to common place errors in alternate spelling of names and addresses, it is important for the implementer to record accurate account numbers. This will assist tracking of participants across programs and tracking to billing data should that be necessary.

- The roll-up of Avista's reported appliance recycling values included only count of appliance type per month, which is then applied to the deemed savings values to estimate the reported program savings. This makes it difficult to determine where any discrepancies may have occurred between the master implementer database and the summarized Avista database. Maintaining as many variables as possible would allow for improved error checking. For example, based on the fact that the JACO database total counts and Avista reported total counts per appliance are different, it appears some errors in data transfer may have occurred, and/or some appliances may have been rebated by Avista that were manufactured after 1994. The cause of the discrepancy is difficult to determine, however, with the variables reported in Avista's summary.

Table 6-6 outlines the Avista reported savings and the evaluation team's gross verified savings based on the methodology described above. The program achieved a 165% realization rate over the 2014 –2015 program cycle, as compared to the adjusted reported savings.

Table 6-6 Appliance Recycling Gross Verified Savings

Measure	2014–2015 Adjusted Reported Participation Count	2014-2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings
Refrigerator	306	198,150	194,616	171%	333,540
Freezer	92	63,774	56,304	147%	82,984
TOTAL	**398**	**261,924**	**250,920**	**166%**	**416,524**

6.3 HVAC Program

6.3.1 Overview

Avista internally manages the HVAC program which encourages the implementation of high efficiency HVAC equipment and smart thermostats through direct incentives issued to the customer after the measure has been installed. The evaluation team used a combination of desk reviews, customer telephone surveys and billing analysis to estimate the gross-verified savings for the applicable measures and the program as a whole.

6.3.2 Program Achievements and Participation Summary

Participation in the 2014–2015 HVAC program totaled 599 measures. Table 6-7 and Figure **6-2** summarize Avista's 2014–2015 HVAC program participation and energy impacts.

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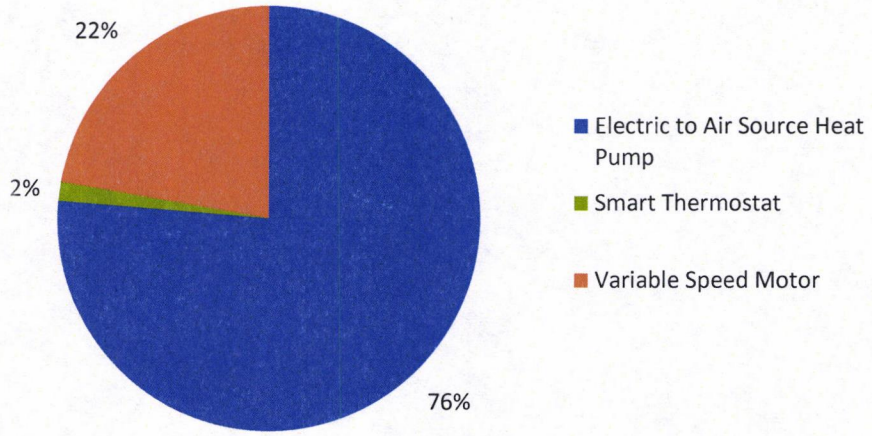
Table 6-7: HVAC Program Reported Participation and Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)
Electric to Air Source Heat Pump	147	666,736
Smart Thermostat	15	12,493
Variable Speed Motor	437	193,599
TOTAL	**599**	**872,828**

Figure 6-2: 2014–2015 HVAC Program Reported Participation Energy Saving Shares



6.3.3 Methodology

The evaluation team investigated measures under the residential HVAC program separately, but utilized similar methods across multiple measures. The following four measure categories were analyzed:

- Air Source Heat Pump (ASHP)
- Electric Variable Speed Motor
- Smart Thermostat

The evaluation team conducted 68 telephone surveys and document audits with program participants and a billing analysis was conducted on all of the measures evaluated as well. As discussed in Section 3.3, these surveys and document audits were conducted to confirm participation in the program, confirm efficiency levels of installed equipment as applicable, check that Avista reported data matched project files and that Avista is reporting the correct savings

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value for each applicable measure. The evaluation team also conducted a review of Avista's complete 2014 and 2015 program databases to check for errors in measure-level reporting.

The subsections below outline the specific evaluation methodology for estimating the gross verified impacts for the ASHP, Electric Variable Speed Motor and the Smart Thermostat measures. The methodology utilized for the natural gas furnaces is presented in the WA Natural Gas Impact Evaluation Report[16].

6.3.3.1 Air Source Heat Pump

To estimate electric savings resulting from participants' installation of air source heat pumps, the evaluation team utilized the fixed-effects panel regression approach described in Section 3.4.4 Billing Analysis. Gross verified energy savings were calculated by comparing billed consumption in months prior to the measure installations to the billed consumption in months after the measure installations.

Utility billing data for participating homes were merged with observed temperature data (HDD and CDD) and program tracking data was used to identify the measure installation dates and designate the pre-retrofit and post-retrofit periods for each customer. In order to estimate impacts directly attributable to the heat pumps, the evaluation team isolated the customers who received an air source heat pump and no additional measures. An indicator variable was generated to designate billing periods that occurred prior to the measure installation (i.e. "pre" period) and billing periods that occurred after the measure installation (i.e. "post" period). The evaluation team required participants to have at least 12 months of "pre" billing data and at least six months of "post" billing data to be included in the analysis. We then estimated fixed-effects panel regression models to estimate the relationship between electric consumption and weather during the "pre" and "post" retrofit periods. Equation 6-1 shows the model specification used to estimate the relationship.

Equation 6-1: ASHP Fixed-Effects Panel Regression Model Specification

$$\mathrm{kWh}_{it} = \beta_i + \beta_1 \times \mathrm{Post}_{it} + \beta_2 \times \mathrm{HDD}_{it} + \beta_3(\mathrm{Post} \times \mathrm{HDD})_{it} + \epsilon_{it}$$

Table 6-8 provides additional information about the terms and coefficients in Equation 6-1.

[16] *WA 2014-2015 Natural Gas Impact Evaluation Report – May 26, 2016*

Table 6-8: ASHP Fixed-Effects Regression Model Definition of Terms

Variable	Definition
kWh_{it}	Estimated consumption in home i during period t (dependent variable)
$Post_{it}$	Indicator variable denoting pre-installation period vs. post-installation period
HDD_{it}	Average heating degree days during period t at home i
β_i	Customer specific model intercept representing baseline consumption
β_{1-3}	Coefficients determined via regression describing impacts associated with independent variables
ϵ_{it}	Customer level random error

The β_1 and β_3 terms in Equation 6-1 describe the average change in daily base kWh and daily kWh per HDD, respectively, in the post-retrofit period. The evaluation team applied these coefficients to the TMY3 normal weather conditions to estimate weather normalized annual electric savings resulting from ASHP installation.

6.3.3.2 Variable Speed Fan Motor

A similar approach was used to estimate electric savings associated with variable speed fan motors. Similar to the ASHP analysis, the evaluation team first isolated the program participants who received a new variable speed motor and no other measures in order to pinpoint the savings directly attributable to the motors. Customers' utility billing data was merged with historic weather records and the pre-installation and post-installation billing periods we designated using the measure installation date from program tracking data. A fixed-effects panel regression model was then estimated to develop the relationship between weather and electric load before and after the variable speed fan improvement was installed.

The model specification used to estimate variable speed motor impacts is slightly different than the model specification used for ASHP. Because the motor is active during both heating and cooling seasons, CDD terms were included in the model specification in addition to the HDD terms. Equation 6-2 shows the model specification used to estimate the impacts of variable speed fan motors.

Equation 6-2: Variable Speed Motor Fixed-Effects Regression Model Specification

$$\mathrm{kWh_{it}} = \beta_i + \beta_1 \times \mathrm{Post_{it}} + \beta_2 \times \mathrm{CDD_{it}} + \beta_3(\mathrm{Post} \times \mathrm{CDD})_{it} + \beta_4 \times \mathrm{HDD_{it}} + \beta_5(\mathrm{Post} \times \mathrm{HDD})_{it} + \epsilon_{it}$$

Table 6-9 provides additional information about the terms and coefficients in Equation 6-2.

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Table 6-9: Variable-Speed Motor Fixed-Effects Regression Model Definition of Terms

Variable	Definition
kWh_{it}	Estimated consumption in home i during period t (dependent variable)
$Post_{it}$	Indicator variable denoting pre-installation period vs. post-installation period
CDD_{it}	Average cooling degree days during period t at home i
HDD_{it}	Average heating degree days during period t at home i
β_i	Customer specific model intercept representing baseline consumption
β_{1-5}	Coefficients determined via regression describing impacts associated with independent variables
ϵ_{it}	Customer level random error

The β_1, β_3 and β_5 terms in Equation 6-2 represent the average change in daily base load, daily kWh per CDD and daily kWh per HDD, respectively, in the post-installation period. These terms were then applied to the normal weather conditions (TMY3) to estimate average weather normalized annual savings associated with variable speed fan motors.

6.3.3.3 Smart Thermostat

Avista offers rebates for the installation of qualified smart thermostat products. These devices have advance features such as occupancy detection, auxiliary heat lockout, economizer capability, and "learning" algorithms to adapt to resident behavior. Avista claims savings based on the heating fuel of the home so electric savings are only claimed for homes that have electric heating systems. The majority of the smart thermostats rebated in 2014–2015 were in homes with natural gas heating systems. The other challenge for evaluation was that uptake of the smart thermostat offering was highest in the fourth quarter of 2015. This meant that participating only had a few months of post-installation billing data at the time of this evaluation. Further complicating the analysis was the fact that a subset of the smart thermostat rebate recipient also installed other HVAC measures such as variable speed fans and high efficiency furnaces at the same time as the smart thermostat.

The evaluation team used propensity score matching to develop a comparison group of homes from the Opower program to serve as a baseline for savings estimates. Only five homes had sufficient post-retrofit billing data to estimate savings. The sample size wasn't sufficient to develop a statistically significant per-home verified savings estimate, but two of the five homes produced savings annual estimates below Avista's per-unit savings value of 961 kWh and three of the five homes produces savings estimates above the reported savings value. Absent any information supporting an adjustment of savings, the evaluation team set the gross verified electric savings equal to reported savings for this measure.

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6.3.4 Findings and Recommendations

6.3.4.1 Air Source Heat Pump

The findings from the telephone surveys, document audit and database review found that all records matched between the Avista reported database and the project documentation. Therefore, the reported savings and the adjusted-reported savings for program count and savings match.

The fixed-effects regression analysis described in Section 6.3.3.1 produced statistically significant reductions in heating loads in homes where air source heat pumps were installed and rebated. Table C- 1 in Appendix C shows the fixed-effects regression output for ASHP rebates. Despite showing statistically significant heating impacts, the gross verified annual savings estimated by the regression approach are well below the deemed savings reported by Avista prior to the analysis. Whereas the average reported ex ante savings for ASHPs was 4,925 kWh, the annual savings estimated by the analysis was 2,390 kWh, resulting in a 48.5% realization rate. The relative precision of the savings estimate for ASHPs was ±19.0% at the 90% confidence level (Table 6-10).

Table 6-10: Air Source Heat Pump Impact Summary

n Homes	Ex Ante kWh	Annual kWh Pre	Annual kWh Post	Delta	RR	Precision at 90% Confidence
109	4,925	20,574	18,183	2,390	48.5%	±19.0%

The evaluation team also ran individual customer regressions using the model specification shown in Equation 6-1 in order to assess the distribution of savings at a more granular level across the measure's participant population. The analysis resulted in an average 12.7% reduction in electric consumption in the "post" period as a result of ASHP installation. Figure 6-3 shows a histogram of the distribution of percent savings across the 109 participants receiving ASHPs.

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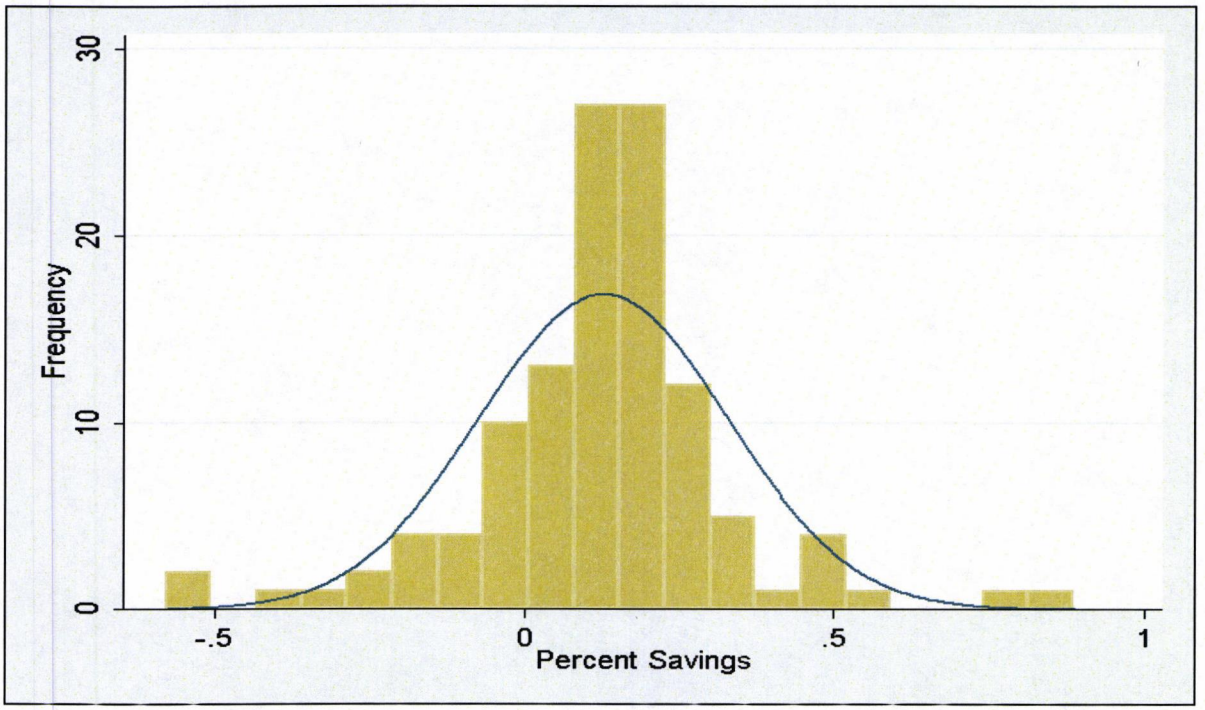
Figure 6-3: ASHP Distribution of Percent Savings



The evaluation team recommends Avista reexamine the assumptions relating to annual per-home consumption and savings estimates in homes receiving ASHP installations.

6.3.4.2 Variable Speed Fan Motor

The findings from the telephone surveys, document audit and database review found a few errors in the program database, resulting in a slight variance between the program reported and adjusted reported values.

The regression approach produced statistically significant impact estimates in both the heating and cooling loads of homes who installed a variable speed fan motor in their homes. Table C-2 in Appendix C provides the full regression output. In addition, annual savings estimated by the regression were nearly at a level consistent with the deemed savings reported by Avista for the program cycle. Table 6-11 summarizes the impacts and realization rate for variable speed fan motor installations. On average, homes achieved 414 kWh annual savings compared to 439 kWh annual savings reported by Avista, resulting in a realization rate of 94.4%.

Table 6-11: Variable Speed Motor Impact Summary

n Homes	Ex Ante kWh	Annual kWh Pre	Annual kWh Post	Delta	RR
592	439	12,111	11,696	414	94.4%

The model specification shown in Equation 6-2 was also used to run separate regressions on each individual customer receiving a variable speed motor. On average, customers receiving a

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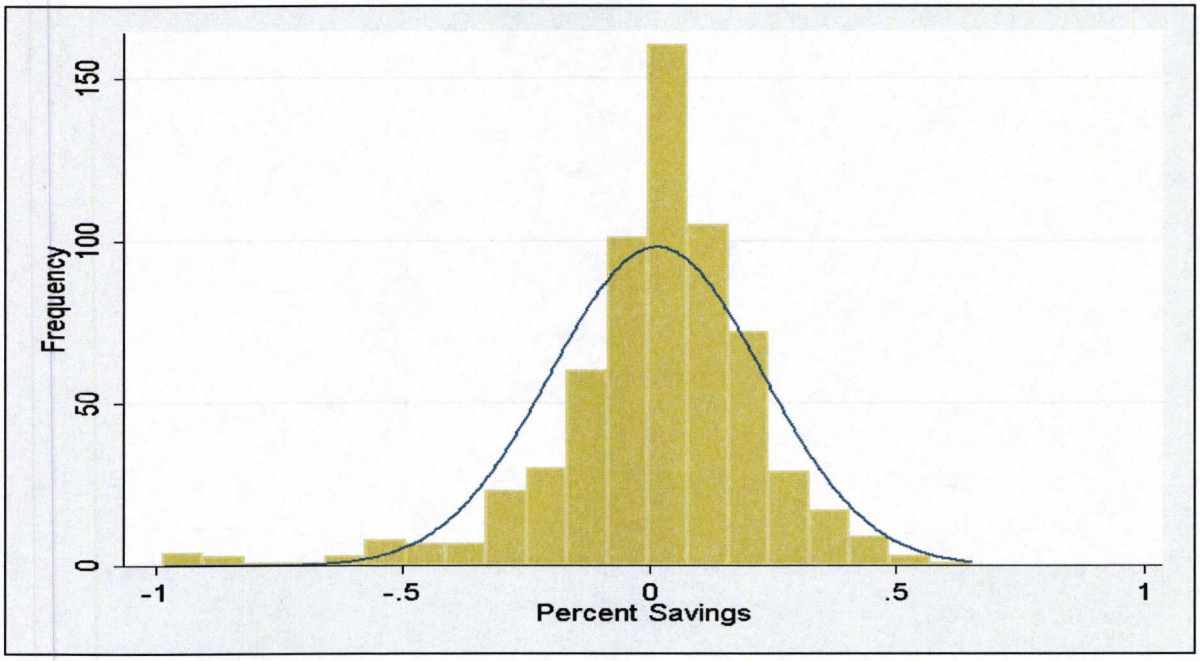
variable speed motor installation achieved a 1.4% reduction in annual electric consumption. Figure 6-4 shows the distribution of percent savings for program participants receiving a variable speed motor rebate.

Figure 6-4 shows a histogram of the distribution of percent savings across the 592 participants receiving variable speed fan motors.

Figure 6-4: Variable Speed Motor Distribution of Percent Savings



6.3.4.3 Smart Thermostat

Given the inconclusive analysis results for this measure driven by data limitations, the evaluation team recommends that Avista revisit the analysis of this measure in late 2016 or early 2017, when a full year of post-installation billing data is available for several hundred rebate recipients. Table 6-12 compares findings from smart thermostat impact evaluation across the country. These studies vary in:

- Location (e.g. weather)
- Sample sizes
- Thermostat product installed and type of thermostat replaced
- Robustness of methodology
- Type of installation (utility direct install, professional, self-install).

The impact estimates of these studies also vary considerably. In general, programs that offer direct replacement of manual thermostats have the highest savings estimates and mass market

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offerings where the replaced thermostat population includes a mix of conventional programmable and manual devices produce lower savings.

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Table 6-12: Comparison of Smart Thermostat Evaluation Results

Study Name	State	Baseline Tstat	Installed Tstat	Sample Size	Control Group, If Any	% Savings Whole House	% Savings Cooling	% Savings Heating
MA PAs: Wi-Fi Programmable Controllable Thermostat Pilot Program Evaluation (9/12)	MA	Manual & Programmable	Ecobee Smart	66 (Gas) 11 (Elec)	23		16%	8%
National Grid: Evaluation of 2013–2014 Smart Thermostat Pilots: Home Energy Monitoring, Automatic Temperature Control, Demand Response (7/15)	MA	Manual	Ecobee Smart	9 (Gas), 15 (Elec)			10%	
National Grid: Evaluation of 2013–2014 Smart Thermostat Pilots: Home Energy Monitoring, Automatic Temperature Control, Demand Response (7/15)	MA	Programmable	Ecobee Smart	26 (gas), 48 (elec)			7.4%	
NIPSCO: Evaluation of the 2013–2014 Programmable and Smart Thermostat Program (9/14)	IN	Manual	Nest	238	469 (Gas) 522 (Elec)	3.9%	16%	13.4%
NIPSCO: Evaluation of the 2013–2014 Programmable and Smart Thermostat Program (9/14)	IN	Manual	Conventional Programmable	217 (Gas) 212 (Elec)	469 (Gas) 522 (Elec)	3.9%	15%	8.0%
Vectren: Evaluation of 2013–2014 Programmable and Smart Thermostat Program (1/14)	IN	Manual	Nest	197 (Gas) 191 (Elec)	2611 (Gas) 2714 (Elec)	4.0%	13.9%	12.5%
Vectren: Evaluation of 2013–2014 Programmable and Smart Thermostat Program (1/14)	IN	Manual	Conventional Programmable	184 (Gas) 205 (Elec)	2611 (Gas) 2714 (Elec)	3.7%	13.1%	5.0%
Xcel: In-Home Smart Device Pilot. Public Service Company of	CO	Not specified	Other Smart or PCT	1,100	N/A	3.3%	4.6%	

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Study Name	State	Baseline Tstat	Installed Tstat	Sample Size	Control Group, If Any	% Savings Whole House	% Savings Cooling	% Savings Heating
Colorado (4/14)								
PG&E: Findings from the Opower/Honeywell Smart Thermostat Field Assessment (7/14)	CA	conventional programmable & manual mix	Other Smart or PCT	423	695	1.0%		
Puget Sound Energy: 2014 Impact Evaluation of PSE's Web-Enabled Thermostat (WET) Program 8/15)	WA	Not specified	Other Smart or PCT	1,000	1,000	-0.2%		
Energy Trust of Oregon Nest Thermostat Heat Pump Control Pilot Evaluation	OR	75% programmable, 25% manual	Nest	185	211	4.7%	NA	12.0%
NV Energy 2013 DR Program Evaluation+A27:R27	NV	not clear	Eco-Factor	2477 (T) 2478 (C)	2,478	5.4%		
ComEd Smart 2016 Thermostat-Annual and Seasonal	IL	most likely blended	Smart (mostly Nest)	1791 (T) 1887 (C)	1,887	1.5%	4.8%	6.7%

6.3.5 Program Results

Table 6-13 outlines the program reported, adjusted, and gross verified savings value for each measure in the HVAC program. The evaluation team found a 60% realization rate across the entire HVAC program. The relative precision of the program level electric realization rate is ±30.5% at the 90% confidence level.

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Table 6-13: HVAC Program Gross Verified Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Electric to Air Source Heat Pump	147	666,736	666,736	49%	326,196
Smart Thermostat	15	12,493	12,493	100%	12,493
Variable Speed Motor	437	193,599	193,599	94%	182,677
TOTAL	**599**	**872,828**	**872,828**	**60%**	**521,365**

6.4 Water Heat Program

6.4.1 Overview

The evaluation team's assessment of the Water Heat program included analysis and verification of electric water heating-related measures offered by Avista including clothes washers, electric water heaters, and low flow showerheads. Both clothes washers and showerhead incentives were offered through the Simple Steps upstream program.

6.4.2 Program Achievements and Participation Summary

Participation in the 2014–2015 Water Heat program totaled 4,306 measures (includes distinct measure and bulb counts). Table 6-14 and Figure 6-5 summarize Avista's 2014–2015 Water Heat program participation and energy impacts.

Table 6-14: 2014–2015 Water Heat Reported Participation and Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)
E Electric Water Heater	19	2,090
Simple Steps Clothes washers	432	57,024
Simple Steps Showerheads*	3,855	180,153
TOTAL	**4,306**	**239,267**

*Inclusive of 1.5, 1.6, 1.75, and 2.0 gpm low flow showerheads and includes nonparticipant savings

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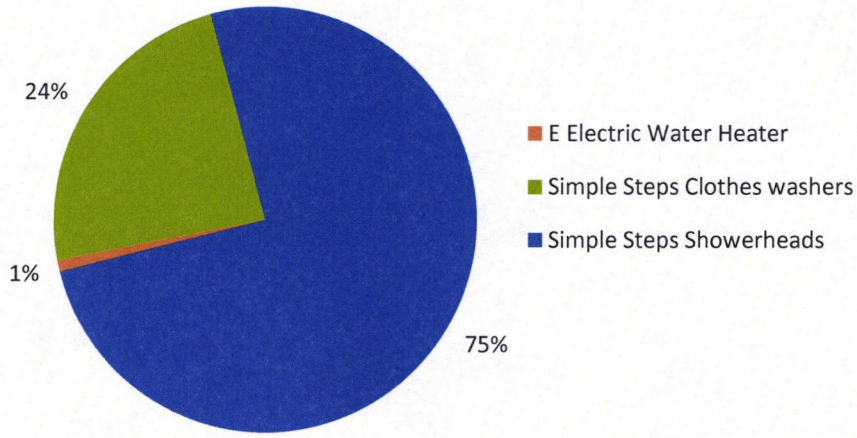
Figure 6-5: 2014–2015 Water Heat Program Reported Participation Energy Saving Shares



6.4.3 Methodology

The evaluation team performed verification of the program measures through a review of sampled project documentation and phone survey responses with program participants. Our review was designed to confirm the program tracking database was aligned with both project documentation and survey data.

Table 6-15 below presents the sampling completed for the Water Heat evaluation. The evaluation team collected information on fuel types and baseline equipment data from participant surveys and compared these data with project applications and supporting invoices. The evaluation team used this information to assess if the data recorded in the program tracking database was accurate.

Because we designed and drew our sample in 2014, clothes washers were not included in the sample as this measure was not offered until 2015.

Table 6-15: Water Heat Program Achieved Sample

Strata	Document Audit	Phone Survey
Clothes Washers	0	0
Electric Water Heater	13	13
TOTAL	**13**	**13**

In addition to the participation verification activities described above, the evaluation team also conducted an engineering analysis to estimate per unit savings for showerheads for each efficiency level. The evaluation team estimated savings from low flow showerheads following Equation 6-3 and the parameters and source for each identified in Table 6-16

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Equation 6-3: Low Flow Showerhead Energy Savings Calculation

$$Energy\ Savings\ (kWh/Year) = \frac{People \times Shower\ Time \times Days \times \%Days \times \Delta GPM \times (T_{SHOWER} - T_{IN}) \times C_P \times Den}{3{,}413 \times RE \times Showerheads}$$

Where:

People = the number of people taking showers (ppl/household)

Shower Time = the average shower length (min/shower)

Days = the number of days per year (day/yr)

%Days = the number of showers per day, per person (shower/day-ppl)

ΔGPM = the difference in gallons per minute for the base showerhead and the new showerhead (gal/min)

TSHOWER = the average water temperature at the showerhead (oF)

TIN = the average inlet water temperature (oF)

CP = the specific water heat (BTU/lb-oF)

Den = the water density (lb/gal)

3,413 = the conversion rate between BTU and kWh

RE = the water heater's energy factor

Total # of Showerheads = the number of showerheads per home

High-Efficiency Showerheads = the number of high-efficiency showerheads installed by the program

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Table 6-16: Low-Flow Showerhead Parameters and Data Sources

Term	Value	Source
People	2.51	U.S. 2010 Census
Shower Time	8.06	Regional Technical Form
Days	365	Conversion Factor (day/yr)
%Days	0.68	Regional Technical Form
ΔGPM	0.3, 0.55, 0.7, 0.8	Program data (efficient case); Regional Technical Form (baseline case)
TSHOWER	105	Secondary source[17]
TIN	52	Secondary source[18]
EFelectric	100%	Regional Technical Form
CP	1	Constant (BTU/lb-oF)
Den	8.33	Constant (lb/gal)
Number of Showerheads	1.91	U.S. 2010 Census; Regional Technical Form

Because the showerheads were either distributed via an upstream or direct install program, the evaluation team assumed an installation rate of 1.0.

Per unit savings were estimated based on these parameter inputs and extrapolated total savings from showerheads based on the measure counts reported by the program implementers. The Simple Steps database provided the overall number of showerheads sold through the program in Idaho; however, no program data was available to determine the proportion of showerheads installed in homes with electric water heating. In order to determine the proportion of homes with electric water heating, the evaluation team leveraged data collected through the 2011 Single Family Regional Building Stock Assessment[19]. We used data specific to Idaho to assign the proportion of Simple Steps showerheads that contributed to electric savings.

Additionally, the Bonneville Power Authority (BPA) reported additional non-participant savings from showerheads under the Simple Steps program. The evaluation team allocated these additional savings based on the same assumed electric water heating saturation for Idaho. We also assigned only a portion of these savings to Idaho as the BPA non-participant savings represented both Avista's Washington and Idaho territories. The evaluation team based the portion assigned to Idaho on Avista's Idaho residential customer base relative to its entire customer base.

[17] DeOreo, William, P. Mayer, L. Martien, M. Hayden, A. Funk, M. Kramer-Duffield, and R. Davis (2011). "California Single-Family Water Use

[18] https://www3.epa.gov/ceampubl/learn2model/part-two/onsite/ex/jne_henrys_map.html

[19] http://neea.org/docs/reports/residential-building-stock-assessment-single-family-characteristics-and-energy-use.pdf?sfvrsn=8

6.4.4 Findings and Recommendations

Based on the review of sampled project documentation and phone survey data, the evaluation team did not identify any errors or corrections needed to the program tracking database. The evaluation team assessed and agreed with the savings value being reported for the Simple Steps clothes washer and electric water heater measures. Therefore, these measures were assigned a 100% realization rate.

The analysis conducted for the low flow showerheads, as described above, resulted in a blended realization rate across the 2.0, 1.75, 1.6 and 1.50 GPM Simple Steps showerheads of 164%.

The main reasons for the large realization rate for the Simple Steps showerheads include:

- The per unit savings are lower than the evaluation team's calculated values most likely due to a difference in some of the parameters discussed in Table 6-16 above.
- The evaluation team assumed that approximately 54% of the showerhead installations savings are tied to an electric water heater, whereas Avista reports 50% toward electric water heater savings.

The total program realization rate and savings are presented in Table 6-17. The relative precision of the program level electric realization rate is ±13.4% at the 90% confidence level.

Table 6-17: Water Heat Program Gross Verified Savings

Measure	2014–2015 Participation Count	2014–2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate (%)	Gross Verified Savings (kWh)
Electric Water Heater	19	2,090	2,090	100%	2,090
Simple Steps Clothes Washers	432	57,024	57,024	100%	57,024
Simple Steps Showerheads	3,855	180,153	180,153	164%	295,561
TOTAL	**4,306**	**239,267**	**239,267**	**148%**	**354,675**

6.5 ENERGY STAR® Homes

6.5.1 Overview

The ENERGY STAR® Homes program provides new home buyers with an $800 rebate for an ENERGY STAR® ECO-rated new manufactured home or $1,000 for an ENERGY STAR® stick-built home. The evaluation team conducted a document review and engineering analysis for a sample of the participating homes and attempted to conduct a billing analysis to estimate gross verified impacts for the program.

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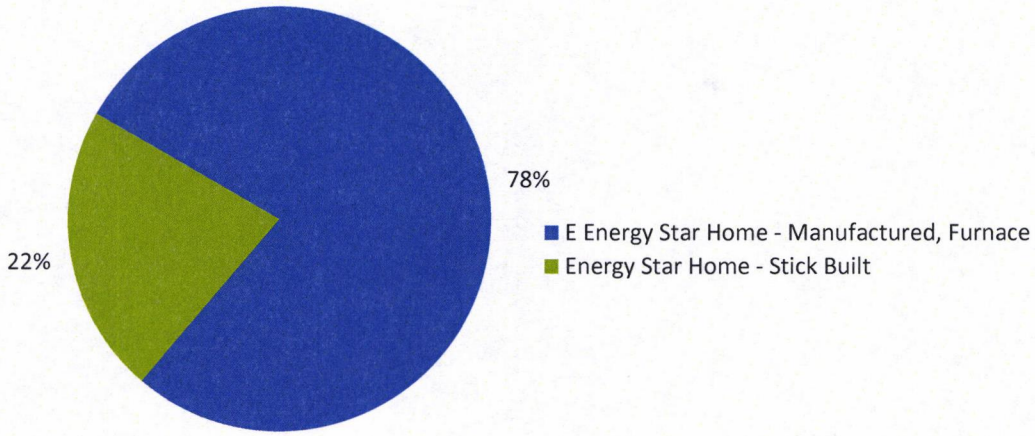
6.5.2 Program Achievements and Participation Summary

Participation in the 2014-2015 ENERGY STAR® Homes program totaled 19 homes. Table 6-18 and Figure 6-6 summarize Avista's 2014 and 2015 ENERGY STAR® Homes program participation and energy impacts.

Table 6-18: 2014–2015 ENERGY STAR® Homes Reported Participation and Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)
Energy Star Home - Manufactured, Furnace	16	109,552
Energy Star Home –Stick Built	3	30,986
TOTAL	**19**	**140,538**

Figure 6-6: 2014–2015 ENERGY STAR® Homes Program Reported Energy Saving Shares



6.5.3 Methodology

The evaluation team initially attempted to use a difference-in-means approach to estimate savings for the ENERGY STAR® Homes program. Utility billing data was used to compare average weather normalized annual consumption of newly built ENERGY STAR® Homes to the weather normalized annual consumption of non-program new meter hookups in Avista service territory, allowing for an estimate of program-related savings. However, due to the small number of ENERGY STAR® Homes participants and absent any detailed characteristics of the homes (e.g. square footage, single- vs. multi-family, etc.) a reliable non-program comparison group could not be attained.

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Instead, the evaluation team collected Home Energy Rating System (HERS) Index scores for participating ENERGY STAR® Homes wherever available. A total of 19 HERS scores were found, including four ENERGY STAR® Stick Built, WA homes and 15 ENERGY STAR Natural Gas homes. A baseline HERS Index score of 80 was assumed as standard for non-program new meter hookups, determined by the 2012 IECC HERS Index Score for climate zone 5.

The evaluation team estimated weather normalized annual consumption for ENERGY STAR® Homes using the same basic model specification shown in Equation 3-1and Equation 3-2. Because these newly built homes do not have a pre-retrofit period, only "post-retrofit" consumption was estimated by the model (in this case, the "retrofit" occurs upon completion of the home or at the time of occupancy).

To estimate what the home's consumption would have been, absent the ENERGY STAR® program, each home's weather normalized annual consumption estimates was scaled up by a weighting factor calculated as the quotient of the base HERS Index score 80 and the home's HERS Index score. Equation 6-4 shows the calculation of estimated consumption absent the program. Note that Equation 6-4 denotes electric consumption for ENERGY STAR® Homes; estimated natural gas consumption absent the program was calculated in exactly the same manner, replacing therms for kWh in Equation 6-4 and Table 6-19 below.

Equation 6-4: Calculation of Consumption Absent Program

$$\mathrm{kWh_{NP}} = \mathrm{kWh_P} \times \frac{\mathrm{HERS_{Base}}}{\mathrm{HERS_{Home}}}$$

Table 6-19 provides additional information about the terms in Equation 6-4.

Table 6-19: Calculation of Consumption Absent Program Definition of Terms

Variable	Definition
$\mathrm{kWh_{NP}}$	Estimated electric energy consumption in home absent the program
$\mathrm{kWh_P}$	Weather normalized annual consumption of the home
$\mathrm{HERS_{Base}}$	2012 IECC HERS Index Score for climate zone 5 = 80
$\mathrm{HERS_{Home}}$	HERS Index Score for the home

Estimated savings for the 15 ENERGY STAR Natural Gas Homes (therms) and four ENERGY STAR® Stick Built, WA Homes (kWh) were calculated individually using each home's specific HERS Index score and averaged for each cohort. HERS Index scores for the remaining ENERGY STAR® Homes were not available, so the evaluation team applied the mean HERS Index score from among the 19 ENERGY STAR® Homes with HERS Index scores and estimated annual consumption absent the program in the same way for these homes, using Equation 6-4.

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6.5.4 Findings and Recommendations

The findings of the HERS Index score approach produced savings estimates exceeding the deemed ex ante savings reported by Avista for the ENERGY STAR® Homes measures. Realization rates were calculated at greater than 100% of reported savings across all measures.

While the results of the HERS Index score approach shows positive savings results, a billing analysis approach with a non-program comparison group would have been the preferred approach. For future evaluations, the evaluation team recommends that Avista track more detailed characteristics of the ENERGY STAR® program homes and non-program homes to allow for a reliable non-participant comparison group billing analysis approach.

Table 6-20 shows calculations for electric savings and realization rate for ENERGY STAR® Stick Built homes in Idaho. Two of these homes did not have adequate billing data to produce reliable weather normalized consumption estimates and consequently were dropped from the analysis. Analysis on these homes estimated approximately 6,861 annual kWh used under program conditions. The HERS Index weight of 1.7 estimated 11,694 kWh annually under non-program conditions, resulting in 4,833 kWh estimated savings.

Table 6-20: ENERGY STAR Home: Results for Stick Built homes in Idaho

n Homes	Ex Ante kWh	Annual kWh	Base kWh	Delta kWh	Weight	Realization Rate
2	4,734	6,861	11,694	4,833	1.7	102%

The evaluation team calculated an average HERS Index score for the 19 homes having individual HERS Index scores. The average score of 49.3 was applied to the remaining subset of ENERGY STAR® - Manufactured, Furnace homes that do not have individual HERS Index scores. Annual consumption and realization rate for these homes are summarized in Table 6-21. Because of the small participation for the ENERGY STAR® Manufactured, Heat Pump homes (one home participated in 2014), the evaluation team applied the same realization to this one participant.

Table 6-21: ENERGY STAR Home: Results for Furnaces in Manufactured Homes

n Homes	Ex Ante kWh	Annual kWh	Base kWh	Delta kWh	Weight	Realization Rate
17	6,847	14,173	23,016	8,843	1.6	129%

6.5.5 Program Results

Table 6-22 outlines the program reported, adjusted, and gross verified savings value for each measure in the ENERGY STAR® homes program. The evaluation team found a 123% realization rate across the entire program. The relative precision of the program level electric realization rate is ±14.4% at the 90% confidence level.

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Table 6-22: ENERGY STAR® Homes Program Gross Verified Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Energy Star Home: Manufactured, Furnace	16	109,552	109,552	129%	141,485
Energy Star Home: Stick Built	3	30,986	30,986	102%	31,635
TOTAL	**19**	**140,538**	**140,538**	**123%**	**173,120**

6.6 Fuel Efficiency

6.6.1 Overview

The fuel efficiency program offers a rebate for the conversion of electric straight resistance heat to natural gas, as well as the conversion of electric hot water heaters to natural gas models. The evaluation team conducted a document review, database review, telephone surveys, and a billing analysis on a sample of the population in order to estimate the gross verified savings for the program.

6.6.2 Program Achievements and Participation Summary

Participation in the 2014-2015 Fuel Efficiency program totaled 405 conversions. Table 6-23 and Figure 6-7 summarize Avista's 2014-2015 Fuel Efficiency program participation and energy impacts.

Table 6-23: 2014-2015 Fuel Efficiency Reported Participation and Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)
Electric to Natural Gas Furnace & Water Heater	170	2,720,510
Electric to Natural Gas Furnace	202	2,426,424
Electric to Natural Gas Water Heater	30	110,949
Electric to Natural Gas Wall Heater	3	32,796
TOTAL	**405**	**5,290,679**

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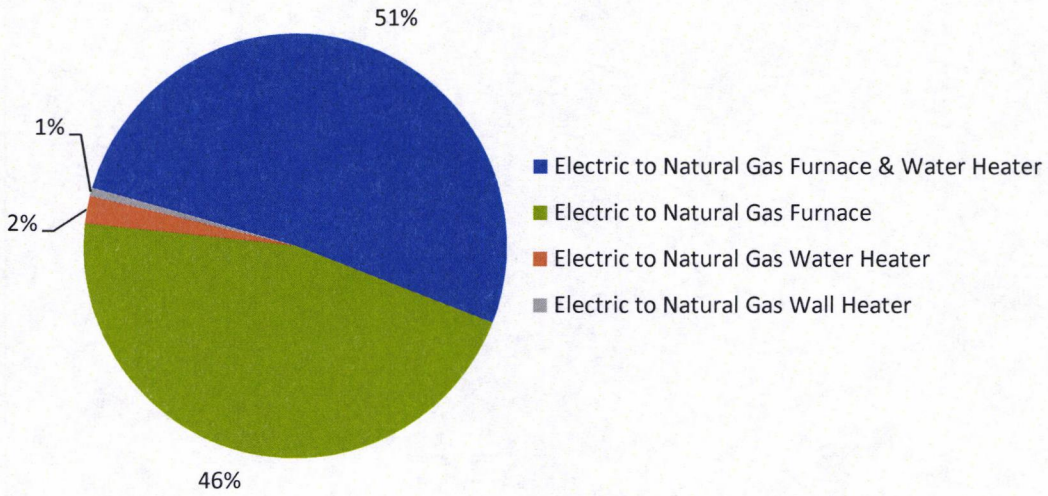
Figure 6-7: 2014–2015 Fuel Efficiency Program Reported Energy Saving Shares



6.6.3 Methodology

The Fuel Efficiency program is a dynamic offering because participants modify the fuel source used for space heating and/or water heating within their residences. These measures produce a large reduction in electric consumption, which is offset to some extent by increased consumption of natural gas. The evaluation team examined both the electric savings and associated gas penalty using an Option C regression analysis of billing data provided by Avista. There are two key factors that affect gas penalty analysis – the first simplifies matters, while the second complicates the analysis and accounting of the gas penalty.

1) Over half of homes that received Fuel Efficiency rebates did not have natural gas service with Avista prior to participation[20]. This means the gas furnace or water heater was installed shortly after gas service was added to the residence. It also makes the gas usage in the home pre-retrofit intuitive—zero therms per year.

2) Approximately 49% of homes that received fuel efficiency incentives from Avista also received rebates for the installation of a high efficiency furnace or water heater. For these homes the observed increase in gas consumption actually overstates the appropriate gas penalty because the gas meter records the consumption of the rebated efficient appliance rather than the code minimum furnace or water heater required of the homeowner to receive a Fuel Efficiency rebate. The difference in consumption between the code minimum appliance that was not installed and high efficiency appliance that was installed are credited as savings in the Gas HVAC and Gas Water Heating programs. This was not the case for Idaho participants because there were no gas

[20] The evaluation team used homes with two of fewer months of gas billing history and more than two months of electric billing history as a proxy for the absence of gas service.

program offerings in Idaho in 2014-2015. However, since this factor affected the overall analysis, it is noted herein.

The evaluation team requested monthly consumption records for each account that received a Fuel Efficiency rebate (both Washington and Idaho) from Avista in 2014 and 2015. Billing records were requested for January 2013 through February 2016 to maximize the quantity of pre- and post-retrofit data available. The team excluded accounts where the meter number changed during the period as this indicates the customer had moved and the consumption data was from two different physical residences. Figure 6-8 provides of breakdown of the remaining 901 homes that received Fuel Efficiency rebates.

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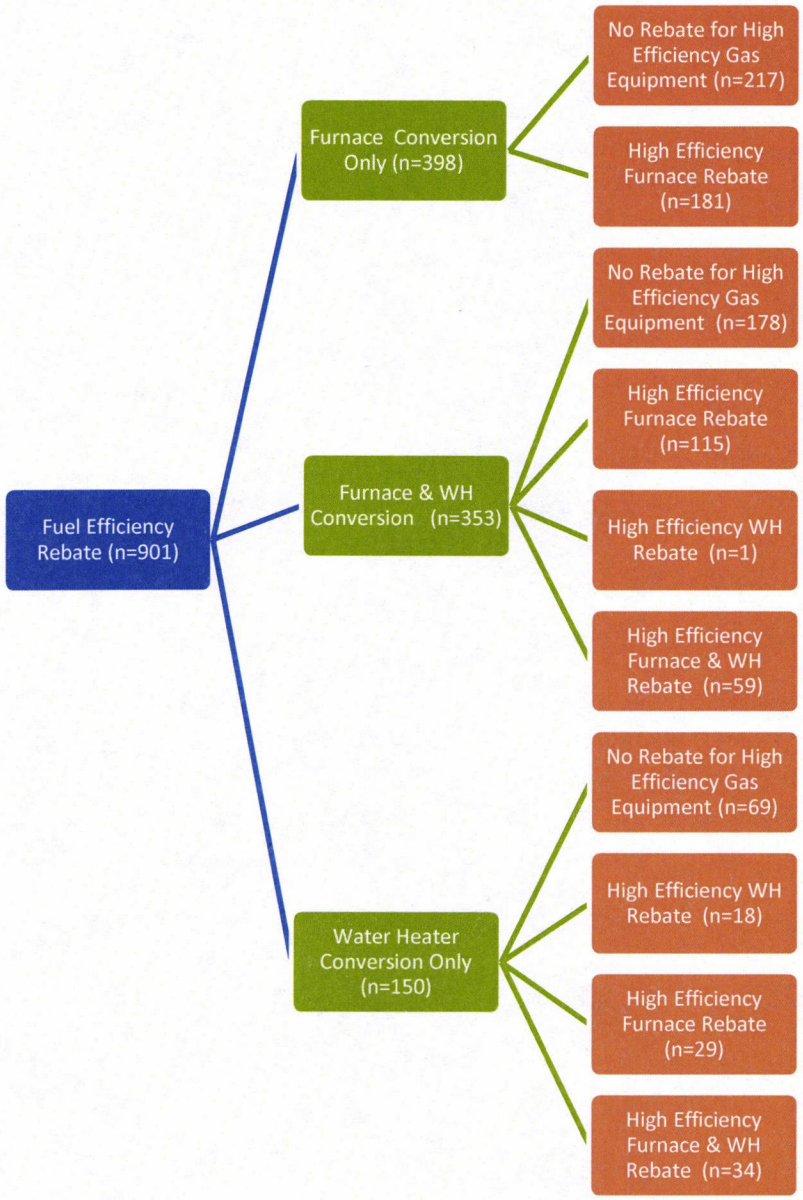
Figure 6-8: Diagram of Fuel Switching Participation



The complexities around secondary rebates for installation of high efficiency rebates were not a major concern for the electric savings analysis because the high efficiency water heater and furnace don't significantly affect the electric usage of the home. The evaluation team did exclude any homes that participated in the Shell rebate program in order to isolate the electric savings from Fuel Efficiency as much as possible. A small number of homes that converted from electric heat to natural gas furnaces also received rebates for installation of a variable speed electric furnace fan, but because the expected fan savings were minimal when compared to the fuel conversion the evaluation team elected not to exclude them from the analysis.

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The evaluation team estimated three separate electric regression models, one for each of the conversion types shown in Figure 6-8. The general form of the electric regression model is shown in Section 3.4.4 of this report and the detailed regression output is presented in Appendix C. In order to maximize the number of homes analyzed the evaluation team relaxed the required number of months for inclusion in the analysis. Homes with at least nine months of pre-retrofit electric billing history and six months of post-retrofit billing history were included in the electric analysis.

Figure 6-9 presents a simplified example of the utility bill regression analysis used to estimate electric savings following receipt of Fuel Efficiency rebates. This example uses a single customer and relies on only heating degree days (HDD) to explain the variation in monthly electric usage. During pre-retrofit period electric consumption rises sharply as weather conditions get colder. In the post-retrofit period the slope of the line is still positive, likely due to increased use of the furnace fan or lighting within the home during cold winter months, but the relationship is much less dramatic than the pre-retrofit period. When the slopes of these lines are applied to an identical expected number of annual HDD, the difference in expected kWh is interpreted as savings attributable to the program. The evaluation team's regression analysis to estimate gross verified savings utilized many homes and also incorporated cooling degree days (CDD) as an independent variable, but the underlying principle is the same.

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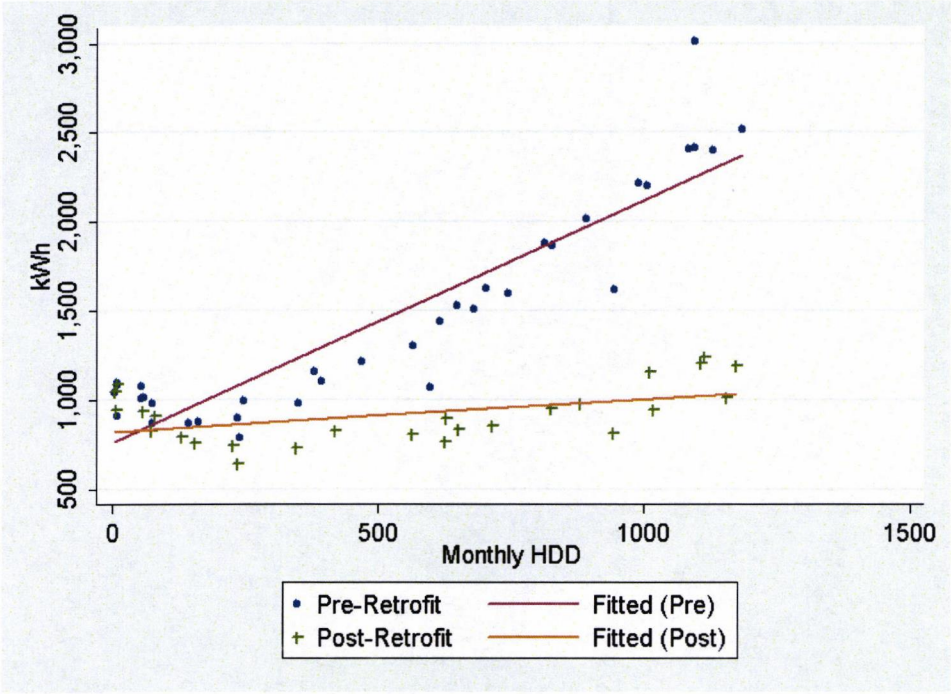
Figure 6-9: Fuel Efficiency Regression Analysis, Example Home



The same process was repeated for homes that converted both furnace and water heater. Almost all of the homes that converted only the water heating type had previous gas service so the penalty for that group was determined using a pre\post analysis of gas consumption in those homes.

In addition, the evaluation team performed verification of the program tracking database and conducted 26 document audits and telephone surveys with customers who participated in the program.

6.6.4 Findings and Recommendations

During the document audit and program database review, the evaluation team did find a few reporting errors, which are reflected in the "adjusted reported" savings value found in the Program Results section below.

Table 6-24 provides detail on the electric billing analyses for the three different fuel conversion paths incented by Avista.

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Table 6-24: Fuel Efficiency Electric Billing Analysis Summary Statistics

Rebate Type	Water Heater	Furnace	Furnace & Water Heater
Number of Homes Analyzed	71	173	102
Average Reported kWh	3,864	12,168	16,211
Average Annual kWh Pre	13,403	19,623	19,355
Average Annual kWh Post	9,647	12,100	10,083
Average Weather Normalized Annual kWh Savings per Home	3,756	7,524	9,272
ELECTRIC REALIZATION RATE	**97%**	**62%**	**57%**

The "Water Heater" column in Table 6-24 includes both tank and wall heaters. These homes used significantly less electricity prior to the conversion than the homes who converted heating systems—likely because a majority of the homes already used fossil fuel heating systems. The regression coefficients in Table C-8 in Appendix C show an expected pattern of savings. The coefficients for the change in heating and cooling loads within the homes are small and not statistically significant. However the coefficient representing the change in daily baseload (1.treatment) is highly significant and estimates an 8.5 kWh per day reduction in non-weather dependent electric load.

The homes that converted heating fuel from electricity to natural gas showed similarly large weather-normalized annual electric pre-retrofit. The furnace-only homes used 19,623 kWh, on average, and the furnace-and-water heater homes used 19,355 kWh annually. The realization rates for the two groups were similar, with the group that converted both systems showing a lower realization rate than the groups that converted just one system.

Appendix C contains the full regression output for these two fuel conversion groups, but the evaluation team also estimated a combined model using both the furnace and furnace-and-water heater homes. The regression coefficients from this analysis are presented in Table 6-25.

Table 6-25: Regression Coefficients from Combined Furnace Conversion Model

Model Term	Coefficient	Lower Bound of 90% CI	Upper Bound of 90% CI
Intercept	14.69	12.59	16.79
Treatment	8.48	6.65	10.31
hdd_ave	2.01	1.89	2.13
treatment*hdd_ave	-1.63	-1.75	-1.51
cdd_ave	2.57	2.33	2.81
Treatment*cdd_ave	-1.16	-1.37	-0.95

As expected, this model estimates a dramatic reduction in the electric heating consumption of homes who replaced their electric heating system with a natural gas furnace. On average homes go from using 2.01 kWh per HDD (base 65 F) to 0.38 kWh per HDD. Interestingly, the

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model also estimates a reduction in cooling usage of 1.16 kWh per CDD from 2.57 to 1.41. Another noteworthy result in Table 6-25 is the estimated increase in base load from 14.69 kWh per day to 23.17 kWh per day. This 3,000 kWh annual increase could be an artifact of the model fit statistics, either because of small sample size or the 65 (F) degree day base is not accurately disaggregating loads within all homes. However, another possibility is that participating homes are undergoing some other fundamental change at the same time as the fuel conversion. Major home improvement projects such as a home addition or finishing a basement, or a change in occupancy within the home could drastically alter the consumption patterns within a home. The evaluation team recommends Avista consider asking participants to indicate on their rebate application if major home renovations are being completed in parallel with the heating system fuel conversion. We believe excluding any such homes from future billing analysis would be justified and limit the possibility of home improvement projects confounding the electric savings estimates from Fuel Efficiency rebates.

6.6.5 Program Results

The electric realization rate for the Fuel Efficiency program was 60%. This program level realization rate was developed by taking a weighted average of the realization rates of the Fuel Efficiency rebate types shown in Table 6-26. The relative precision of the program level electric realization rate was ±6.9% at the 90% confidence level.

Table 6-26: Fuel Efficiency Program Reported and Gross Verified Savings

Measure	2014–2015 Reported Participation Count	2014-2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Electric to Natural Gas Furnace & WH	170	2,720,510	2,725,610	57%	1,558,909
Electric to Natural Gas Furnace	202	2,426,424	2,426,424	62%	1,500,287
Electric to Natural Gas Water Heater	30	110,949	110,949	97%	107,825
Electric to Natural Gas Wall Heater	3	32,796	32,796	97%	31,873
TOTAL	**405**	**5,290,679**	**5,295,779**	**60%**	**3,198,893**

6.7 Residential Lighting Program

6.7.1 Overview

In 2014 and 2015, the Avista residential lighting program was comprised of two delivery streams: Simple Steps, and the Avista Bulb Giveaway.

The Simple Steps, Smart Savings™ program provides discounts to manufacturers to lower the price of efficient light bulbs, light fixtures, showerheads, and appliances. This program, launched by Bonneville Power Administration (BPA) and administered by CLEAResult, operates across

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the Pacific Northwest. Utilities may select which reduced-price items to include in their territory. Avista's offerings included a selection of general and special CFLs, LED light fixtures, and LED bulbs that were clearly identified with a sticker indicating they were part of the Simple Steps, Smart Savings program. Retailers—big-box stores, regional chains, and national chains—were the primary recipients of the products and typically selected from Avista's approved options for each store location. Additionally, Simple Steps program provided Avista with an allocation of additional residential lighting savings from non-participating utilities; this subprogram is called "Simple Steps – NP". Finally, Avista gave its customers free, energy-efficient lighting products, specifically CFL and LED lamps, at corporate and regional events.

6.7.2 Program Achievements and Participation Summary

Table 6-27 and

Figure 6-7 summarize Avista's 2014 and 2015 residential lighting program participation and energy impacts.

Table 6-27: 2014–2015 Residential Lighting Reported Participation and Savings

Measure	2014–2015 Reported Participation Count (Bulbs)	2014–2015 Reported Savings (kWh)
Simple Steps—LED	89,124	1,846,600
Simple Steps—CFL	372,227	6,371,184
Simple Steps – NP—LED	420	6,376
Simple Steps – NP—CFL	4,645	70,970
Giveaway—CFL	1,824	27,360
Giveaway—LED	379	1,352
TOTAL	**468,619**	**8,323,842**

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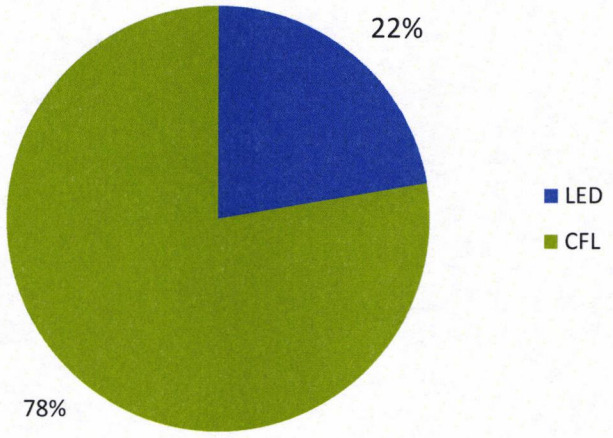
Figure 6-10: Distribution of Lighting Energy Savings by Technology Type



Reported energy savings are based on a per-lamp basis, using a deemed value for each lamp product type and delivery approach (i.e. retail, direct installation, giveaway) based on legacy regional technical forum values.

6.7.3 Methodology

The lighting program gross impact analysis involved three distinct program components, although each component ultimately depended on the same calculation and parameters to estimate gross impacts. The underlying values for the input parameters were the only differentiation across program components. Therefore, to simplify the approach and methodology for the program, the evaluation team included a review of each of the key parameters associated with energy savings. The team relied on savings protocols as specified in the DOE-UMP. The UMP includes a full chapter on residential lighting evaluation protocols.[21]

The annual kWh savings for the lighting program are dependent on several key parameters. The annual energy savings produced when a CFL or LED bulb replaces an incandescent bulb is calculated as shown in Equation 6-5 :

Equation 6-5: Calculation of Consumption Absent Program

$$Annual\ kWh\ Savings = Total\ bulbs \times \Delta Watts \times 365.25 \times HOU_{Daily} \times ISR \times IE$$

Where:

[21] Residential Lighting Chapter (21) in the UMP: http://energy.gov/sites/prod/files/2013/11/f5/53827-6.pdf.

$Annual\ kWh\ Savings$ = *The average annual energy savings from replacing the incandescent bulb with a more efficient bulb*

$Total\ bulbs$ = *The total number of verified program incentivized bulbs*

$\Delta Watts$ = *The change in connected load (baseline minus efficient wattage)*

HOU_{Daily} = *The average operating hours per day the light is turned on*

365.25 = *Average number of days per year (to annualize daily HOU)*

ISR = *The in-service rate*

IE = *The interactive effects (loss of inefficient bulb waste heat).*

Table 6-28 shows each of the key parameters and the inputs for each parameter for the gross savings analysis. More detail about the data sources/collection activities and parameter estimates is presented in the remainder of this section.

Table 6-28: Lighting Program Parameters and Sources

Parameter	CFL Retail	LED Retail	CFL Giveaway
Number of Bulbs	Tracking Database	Tracking Database	Tracking Database
Hours of Use	2015 Light Metering Study—Evaluation	2015 Light Metering Study—Evaluation	2015 Light Metering Study—Evaluation
Delta Watts	Tracking Database, EISA Mapping	Tracking Database, EISA Mapping	Participant Survey
In-Service Rate	Regional Technical Forum; UMP	Regional Technical Forum	Regional Technical Forum; UMP
Cross Sector Leakage	Retailer Interviews	Retailer Interviews	Not applicable
Interactive Effects	Regional Technical Forum	Regional Technical Forum	Regional Technical Forum

6.7.3.1 Total Program Bulbs

The evaluation team verified the number of CFL and LED lamps, product type, location, and the bulb wattage distributed via the Simple Steps program via a database review for the State of Idaho. For internal reporting, Avista uses a 70%/30% split to separate the total Simple Steps units between its Washington and Idaho service territories, respectively. During the review of the program database, the evaluation team found that 28.2% of the total units were actually in the Idaho service territory. Because of this 0.2% difference between Avista's internal reporting method and the numbers in the database, a slight difference appears between the total units shown in Table 6-27 and in Table 6-29. The actual lamp unit counts in Table 6-29 were used in the evaluation analysis.

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Table 6-29: Verified Residential Lighting Unit Counts by Lamp Type and Delivery Stream

Program Delivery Stream	Lamp Type	Unit Counts
Simple Steps	CFL General Purpose	342,094
	CFL Specialty: Reflector	41,637
	CFL Specialty: Globe	733
	CFL Specialty: Candelabra	737
	CFL Specialty: 3-way	648
	CFL Fixture	2,104
	CFL Subtotal	**387,953**
	LED General Purpose	61,803
	LED Specialty: Reflector	1,733
	LED Specialty: Globe	56
	LED Specialty: Candelabra	506
	LED Specialty: 3-way	186
	LED Fixture	2,639
	LED Subtotal	**66,923**
Simple Steps - NP	CFL General Purpose	4,237
	CFL Specialty: Reflector	261
	CFL Specialty: Globe	13
	CFL Specialty: Candelabra	59
	CFL Specialty: 3-way	3
	CFL Fixture	73
	CFL Subtotal	**4,645**
	LED General Purpose	266
	LED Specialty: Reflector	98
	LED Specialty: Globe	6
	LED Specialty: Candelabra	21
	LED Specialty: 3-way	0
	LED Fixture	26
	LED Subtotal	**420**
Giveaway	LED General Purpose	379
	CFL General Purpose	1,824
TOTAL		**462,144**

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6.7.3.2 Hours of Use

As part of the evaluation of residential lighting, the team conducted a large-scale residential lighting hours-of-use (HOU) study by collecting usage data from onsite metering of lighting fixtures in the homes of Avista customers. The study methodology aligns with the Department of Energy (DOE) Uniform Measure Project (UMP) for residential lighting. The research team measured how many hours per day various lighting fixtures were illuminated during a six-month study period beginning July 2015 and lasting through January 2016, at the residences of 74 Avista customers. An average of seven lamps per home were metered across a random sample of fixture and room types, with 522 lighting meters deployed across Avista's service territory. Collecting data for an average of seven lamps per residence enabled the team to gather a large dataset for analysis across multiple delivery streams, residence, and room types. Metered lamps included both efficient lamps (CFLs and LEDs) and inefficient lamps (incandescents and halogens). A full inventory of lighting (fixture, socket, lamp type, etc.) was also performed while onsite. Chapter 8 details the residential lighting hours-of-use study.

As a study outcome, the measured hours of use for residential lighting bulbs appear in Table 6-30.

Table 6-30: Verified Hours of Use for Residential Lighting

Room (Logger level, weighted by event type)	Annualized Room-Based HOU/day
Kitchen	3.75
Dining	2.48
Living/Great/Family	2.41
Foyer/Hall/Stair	1.25
Bedroom	1.25
Toilet/Bathroom	1.82
Other	1.52
TOTAL WEIGHTED AVERAGE	**1.94**

Because the room type and previous bulb technology of the installed residential lamp is unknown, the total weighted average hours of use of 1.94 hours per day was applied for all residential premises. This value is identical to the Regional Technical Forum value for 60W-equivalent screw-in lamps delivered through a retail markdown channel in the most current UES assumptions.

6.7.3.3 Delta Watts

Delta watts represent the difference between the wattage of the assumed baseline product and the wattage of the CFL or LED. For the CFL and LED markdown programs, the evaluation team first assessed Energy and Independence Security Act (EISA) eligibility for each program bulb

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product type, segmenting the bulbs into a few groups: EISA-qualified general service lamps (GSL), EISA-qualified reflectors, decorative lamps, and globes. These categories were assigned baselines considering lumen equivalency and "bin mapping,"[22] as summarized Table 6-31 and Table 6-32

Table 6-31: Standard Lamp Baseline Wattage for Equivalences

Minimum Lumens	Maximum Lumens	Incandescent Equivalent Wattage	
		Baseline (Exempt Bulbs)	Baseline (Post-EISA)
2,000	2,600	150	72
1,600	1,999	100	72
1,100	1,599	75	53
8000	1,099	60	43
450	799	40	29
310	449	25	15

Table 6-32: Decorative and Globe Lamp Baseline Wattage for Equivalences

Lumen Bins		Incandescent Equivalent Wattage	
Decorative Shape	Globe Shape	Baseline (Exempt Bulbs)	Baseline (Post-EISA)
	1,100–1,300	150	72
	650–1,099	100	72
	575–649	75	53
500–699	500–574	60	43
300–499	350–499	40	29
150–299	250–349	25	15
90–149		15	15
70–89		10	10

For some product type, the lumen bin is documented by Simple Steps and is easy to map to these EISA bins. For other products, only the efficient case wattage of the product type is known; the evaluation team correlated the wattage to the equivalent lumen bin for each lighting technology (i.e. CFL or LED) through market research.

For the assessment of gross verified energy savings, the post-EISA baseline was used for each product type and wattage. Additionally, the evaluation team calculated a market baseline considering the composition of lamp types found from onsite inspections in the lighting study; respective EISA equivalent baselines; and efficient case wattage to determine the free-ridership

[22] "Bin mapping" refers to the assignment (or "mapping") of lumen-based equivalent bulbs based on ranges (or "bins") to determine baseline watts.

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market effects, in which a customer likely replaced an expired efficient technology with a like technology. Refer to the description in Appendix E for additional information.

6.7.3.4 Interactive Effects

The team considered heating and cooling interactive effects associated with replacing standard incandescent light bulbs with higher efficiency lighting technology. CFLs and LEDs release substantially less heat into the room, leading to increased heating and decreased cooling loads for a home.

The evaluation team used a single, deemed value of 93.4% to estimate the impacts of the heating, ventilating, and air conditioning (HVAC) system based on assumptions from the most recent RTF residential lighting UES calculation model. Stated differently, the electric energy savings of the efficient lamp were effectively reduced by 6.6% because of the necessary increase in electric heating. However, the evaluation team believes that this reduction factor is likely high for Avista's service territory, because gas-heated homes are more prevalent there than in the Pacific Northwest at-large.

6.7.3.5 Installation Rate

The installation rate, also commonly referred to as the in-service rate (ISR), represents the percentage of program bulbs purchased that are ultimately installed by program participants. This rate quantifies customers' common practice of waiting to replace a bulb until it has burned out, which can lead to product storage and deferred installation. Retail and giveaway programs distribute the bulbs but do not guarantee that customers actually install the bulbs.

For the CFLs distributed as part of the Simple Steps retail program and Avista giveaway delivery channels, the evaluation team used first-year installation rates of 76% from the most recent RTF residential lighting UES calculation model and RBSA[23]. This installation rate only considers the first-year installation rate; it is well understood that stored lamps will eventually be installed by the customer[24]. Because Avista reports program savings on a first-year, annualized basis, the evaluation discounted the future savings of stored lamps back to present value. The RTF UES calculation model recognizes that stored lamps will be installed in the future, but elects to only apply a 109% savings factor in the future and does not provide a present value that can be used in evaluations with first-year savings values.

The evaluation team followed industry-standard DOE-UMP protocols to forecast the future installation trajectory for both program components. Trajectory refers to the installation rates to account for installations that occur in the years following the program year in which the bulb was purchased. The UMP trajectory leverages a comprehensive multi-year study that tracked installations for the same group of participants. A review of the trajectory calculations is included

[23] 24% Storage Rate; Ecotope Inc., "2011 Residential Building Stock Assessment: Single-Family Characteristics and Energy Use", prepared for the Northwest Energy Efficiency Alliance, September 2012.

[24] Section 4.12 Residential Lighting Chapter (21) in the UMP: http://energy.gov/sites/prod/files/2013/11/f5/53827-6.pdf.

in Table 6-33 below. The team used 20-year Treasury bill rates, currently 2.3%, as the rate to discount future installation savings. Using the 2.3% discount rate and accounting for years two through four for installations per the UMP, the final estimated CFL markdown installation rate was 97.5%.

Table 6-33: In-Service Rate Trajectory for Markdown and Giveaway CFL based on UMP

Year	Incremental % Installed	Total % Installed	ISR Calculation	Retail/ Giveaway
Year 1	NA	NA	Researched Value	76%
Year 2	41%	41%	(Storage %Y1 * 41%)+ISR Y1	85.8%
Year 3	28%	69%	(Storage %Y1 * 69%)+ISR Y1	92.6%
Year 4	NA	NA	Default to 97%	97.0%
OVERALL ISR	**NA**	**NA**	**NPV Y1->Y4**	**97.5%**

Consistent with the RTF assumption, the team chose to apply a 100% installation rate for LEDs because:

- Limited or no applicable or equivalent research has been completed for LED bulbs
- The LEDs were purchased as single packs; the CFLs were purchased as multipacks, encouraging customers to place them in storage
- The higher prices of LEDs would likely lead to limited, if any, stockpiling.

Finally, consistent with the RTF assumption, the evaluation team applied a 2% removal rate for all lamps removed before expiration.

6.7.3.6 Cross-Sector Sales Leakage

The Simple Steps, Smart Savings program promotes the sales of CFL and LEDs to residential customers. Avista currently only reports savings for this offering through their residential lighting program. However, because of the delivery mechanism of the program via in-store, buy-down promotions, the evaluation team sought to understand if nonresidential customers were purchasing bulbs discounted through the program and, if so, what percentage of Simple Steps bulbs were "leaking" into the nonresidential sector. The evaluation team estimated this "leakage" into the commercial sector using the responses of customers (participants and nonparticipants), as well as by conducting a survey of large retailers that sell Simple Steps items. The evaluation team's activities are outlined in the process evaluation report of Avista Utilities 2014 and 2015 energy efficiency programs. Figure 6-11 summarizes the evaluation team findings from surveys of customers and retailers for CFL and LED lamps.

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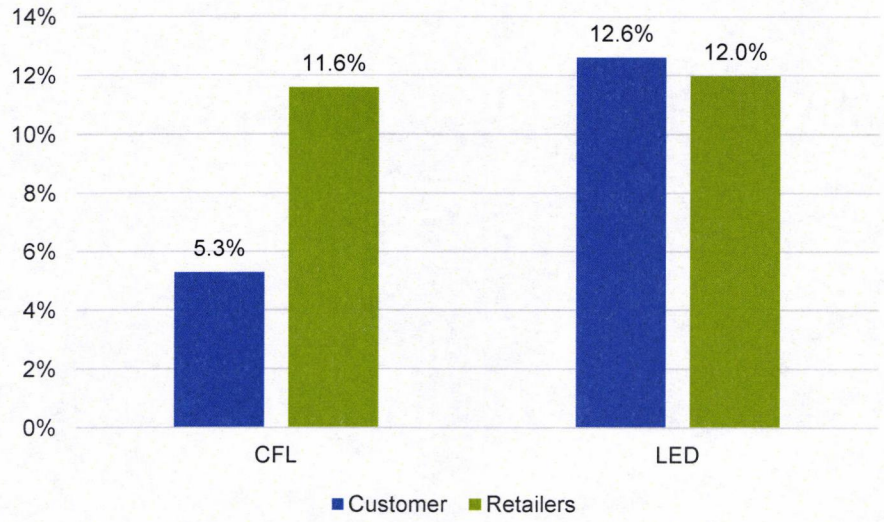
Figure 6-11: Estimates of Percentage of Products in Commercial Sector



Additionally, the evaluation team used the RTF nonresidential operating characteristics to inform the nonresidential HOU: 8 hours per day as a weighted average across the business types[25]. The commercial parameter assumptions, including operating hours and in-service rates, are included in Table 6-34.

Table 6-34: Nonresidential Lighting Input Parameter Assumptions

Parameter	CFL bulbs	LED bulbs
Hours of Use	8.0	8.0
Cross Sector Sales Shares	8.4%	12.3%

6.7.4 Findings and Recommendations

The verified unit counts, verified energy savings, and average savings per lamp are summarized in Table 6-36 for each product type in the residential lighting program.

[25] This value is from market research Nexant conducted for the State of Pennsylvania as the Statewide Evaluator (SWE). http://www.puc.pa.gov/pcdocs/1340978.pdf

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Table 6-35: Verified Residential Lighting Energy Savings by Lamp Type and Delivery Stream

Program Delivery Stream	Lamp Type	Unit Counts	Verified Energy Savings (kWh)	Average kWh/bulb
Simple Steps	CFL General Purpose	342,094	7,430,156	22.3
	CFL Specialty: Reflector	41,637	993,917	23.5
	CFL Specialty: Globe	733	21,811	29.4
	CFL Specialty: Candelabra	737	19,878	26.7
	CFL Specialty: 3-way	648	24,476	37.8
	CFL Fixture	2,104	96,589	45.9
	CFL Subtotal	**387,953**	**8,586,828**	
	LED General Purpose	61,803	1,542,708	22.8
	LED Specialty: Reflector	1,733	39,064	32.5
	LED Specialty: Globe	56	1,136	20.3
	LED Specialty: Candelabra	506	9,176	18.1
	LED Specialty: 3-way	186	8,775	45.1
	LED Fixture	2,639	79,369	30.1
	LED Subtotal	**66,923**	**1,630,230**	
Simple Steps – NP	CFL General Purpose	4,237	101,593	24.0
	CFL Specialty: Reflector	261	6,640	25.4
	CFL Specialty: Globe	13	373	28.7
	CFL Specialty: Candelabra	59	1,317	22.4
	CFL Specialty: 3-way	3	96	32.0
	CFL Fixture	73	3,345	45.9
	CFL Subtotal	**4,645**	**113,364**	
	LED General Purpose	266	7,992	30.1
	LED Specialty: Reflector	98	3,348	34.1
	LED Specialty: Globe	6	130	20.3
	LED Specialty: Candelabra	21	417	20.3
	LED Specialty: 3-way	0	18	41.8
	LED Fixture	26	782	30.1
	LED Subtotal	**420**	**12,687**	

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Program Delivery Stream	Lamp Type	Unit Counts	Verified Energy Savings (kWh)	Average kWh/bulb
Giveaway	LED General Purpose	379	9,321	30.1
	CFL General Purpose	1,824	54,858	24.6
TOTAL		**462,144**	**10,457,288**	

The electric realization rate for the residential lighting program is 131%, as shown in Table 6-36. The relative precision of the program-level electric realization rate is ±13.5% at the 90% confidence level, largely based on the residential lighting hours-of-use study.

Table 6-36: Residential Lighting Realization Rates and Gross Verified Savings

Delivery Stream	2014-2015 Participation (unit counts)	2014-2015 Reported Savings (kWh)	Realization Rate	2014-2015 Gross Verified Savings (kWh)
Simple Steps—LED	66,923	1,846,600	91.0%	1,680,230
Simple Steps—CFL	387,953	6,371,184	134.8%	8,586,828
Simple Steps – NP—LED	420	6,376	199.0%	12,687
Simple Steps – NP—CFL	4,645	70,970	159.7%	113,364
Giveaway —CFL	1,824	27,360	200.5%	54,858
Giveaway—LED	379	1,352	689.4%	9,321
TOTAL	**462,144**	**8,323,842**	**125.6%**	**10,457,288**

The key factors for the realization rates that were greater than 100% are summarized below:

- Avista's deemed savings estimates, which were generally the same for all similar product types, and not correlated to the bulb wattage, understated the savings, in particular for the giveaway program; improved data illuminated the actual savings
- For product types where Simple Steps and Avista reported a weighted-average energy savings value for multiple lamp wattages, the actual weighted-average, verified-lumen bin was greater than the assumed value, resulting in higher savings
- Verified cross-sector nonresidential sales and the corresponding increase in hours of use meant realization rates over 100%.

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6.8 Shell Program

6.8.1 Overview

Avista's internally managed shell program incentivizes measures that improve the integrity of the home's envelope such as insulation (attic, floor and wall), and window replacements. The evaluation team conducted a database review, document audits, customer telephone surveys, and a billing analysis to estimate the adjusted reported and gross verified savings for the program.

6.8.2 Program Achievements and Participation Summary

Participation in the 2014 and 2015 Shell program totaled 370 projects. Table 6-37 and Figure 6-12 summarize Avista's 2014 and 2015 Shell program participation and energy impacts.

Table 6-37: 2014–2015 Shell Program Reported Participation and Savings

Measure	2014-2015 Reported Participation Count	2014-2015 Reported Savings (kWh)
Attic Insulation*	45	46,172
Floor Insulation	12	17,946
Wall Insulation	17	35,948
Window Replacement from Single Pane*	146	505,897
Window Replacement from Double Pane	150	297,701
TOTAL	**370**	**903,663**

*Includes projects and savings for gas measures that reported electricity savings

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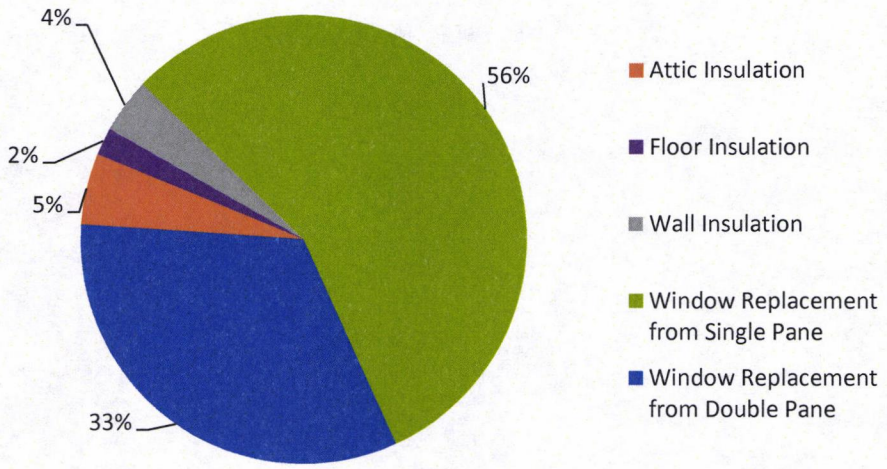
Figure 6-12: 2014–2015 Shell Program Reported Energy Saving Shares



6.8.3 Methodology

The evaluation team merged electric billing data from participating homes with historic weather conditions (HDD and CDD) and program tracking data was used to code the pre-retrofit and post-retrofit period for each home. The evaluation team then estimated fixed effects panel regression models to develop a mathematical relationship between weather and electric load before and after the Shell improvements were installed. Equation 6-6 shows the form of the model and the text below defines the model terms.

Equation 6-6: Fixed-Effects Panel Regression Model Specification

$$kWh_{it} = \beta_i + \beta_1(Post)_{it} + \beta_2(CDD)_{it} + \beta_3(Post \times CDD)_{it} + \beta_4(HDD)_{it} + \beta_5(Post \times HDD)_{it} + \varepsilon_{it}$$

Where:

kWh_{it} = Estimated energy usage (dependent variable) in home *i* during period *t*
$Post_{it}$ = Dummy variable indicating whether period *t* was pre- or post-retrofit
CDD_{it} = Average cooling degree days (base 65 F) during period *t* at home *i*
HDD_{it} = Average heating degree days (base 65 F) during period *t* at home *i*
ε = Customer-level random error
β_i = The model intercept for home *i*
$\beta_{1\text{-}5}$ = Coefficients determined via regression

The β_1, β_3, and β_5 terms in Equation 6-6 represent the average change in daily baseload, daily kWh per CDD, and daily kWh per HDD respectively. The evaluation team used these coefficients and normal weather conditions (TMY3) for the three chosen weather stations to estimate the average weather normalized annual savings.

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In order to construct the electric Shell Rebate analysis data set, the evaluation team implemented the following data preparation steps. The number of unique homes remaining for analysis after each filter is shown in parentheses.

- Identify the homes that participated in the Shell program and had billing data provided by Avista to the evaluation team **(2,724)**
- Exclude homes that also participated in other Rebate programs to ensure Shell impact estimates are not confounded with impacts from the Fuel Efficiency, HVAC, or other programs. **(2,514)**
- Limit the data set to homes with reported kWh savings and electric billing data **(1,991)**
- Exclude homes with fewer than 12 months of pre-retrofit billing history **(908)**
- Exclude homes with fewer than 12 months of post-retrofit billing history **(767).**

In addition to the billing analysis activities noted above, the evaluation team performed verification of the program tracking database and conducted 28 document audits of participating projects.

6.8.4 Findings and Recommendations

6.8.4.1 Shell Rebate Measures

The evaluation team's regression analysis produced statistically significant reductions in both the cooling and heating loads of homes that implemented the Shell Rebate measures (attic, floor and wall insulation, and window replacements). Appendix C presents the full regression output for the Shell Rebate measures, and the key outputs are summarized in Table 6-38. On average, homes were savings 0.14 kWh per CDD and 0.05 kWh per HDD in addition to 0.39 kWh per day reduction in non-weather dependent electric usage.

Table 6-38: Shell Rebate Model Coefficients

Model Term	Pre-Retrofit	Post-Retrofit	Savings
Base Load	20.04	19.65	0.39
Daily kWh per CDD	1.77	1.63	0.14
Daily kWh per HDD	0.75	0.70	0.05

Although the electric reductions from Shell Rebate measures are statistically significant in both the heating and cooling season, the gross verified savings estimate is well below the reported savings values for the analyzed homes. The average reported savings per home was 1,406 kWh and the average verified savings was 537 kWh. This result equates to a realization rate of 38.2% (Table 6-39) and a 4.1% average reduction in total weather normalized electric consumption (Table 6-40).

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Table 6-39: Shell Rebate Gross Verified Savings Summary

# Homes	Average Reported kWh	Annual kWh Pre	Annual kWh Post	Gross Verified kWh Savings	Realization Rate
767	1,406	13,021	12,484	537	38.2%

The relative precision of the savings estimate is ± 24.8% at the 90% confidence level. Although the per-home margin of error is actually reasonably tight at ± 133 kWh/year, the precision suffers when considered on a relative basis because of the lower than expected impacts. Table 6-40 provides some additional relevant measurements of the estimated gross verified energy savings along with the upper and lower bound of the 90% confidence interval.

Table 6-40: Precision of Findings

Impact Statistic	Point Estimate	Lower Bound of 90% Confidence Interval	Upper Bound of 90% Confidence Interval
Gross Verified kWh per Home	537	404	670
Realization Rate	38.2%	28.7%	47.6%
Percent Reduction in Whole House Electric Usage	4.1%	3.1%	5.1%
Percent Reduction in Cooling Usage	7.9%	1.8%	14.0%
Percent Reduction in Electric Heating Usage	6.8%	3.0%	10.5%

The evaluation team also examined the performance of Shell Rebate measure categories (window upgrade and insulation) to investigate if the low realization was being driven by a particular measure. Table 6-41 shows the results of this more granular analysis. Savings for homes that received rebates for insulation and windows, both, were not examined.

Table 6-41: Shell Rebate Performance by Measure Category

Parameter	Window Upgrade (Electric Heat)	Window Upgrade (Gas Heat)	Insulation Upgrade (Electric Heat)
Number of Homes Analyzed	209	503	27
Average Reported kWh	2,539	737	1,319
Annual kWh Pre	18,762	10,351	18,516
Annual kWh Post	17,993	9,925	18,254
kWh Savings	769	426	262
REALIZATION RATE	**30%**	**58%**	**20%**

Avista claims a modest electric savings from gas heated homes that install efficient windows – on average 737 kWh per home as shown in Table 6-41. This group's verified savings estimates were closest to the reported values of the three categories analyzed, although none of the differences between groups are statistically significant.

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The regression coefficients summarized in Table 6-42 may also help explain the low realization rate for Shell Rebate measures. The evaluation team's regression analysis estimates that prior to retrofit, participating homes were using slightly more than 13,000 kWh annually, but only approximately 5,500 kWh of this consumption was weather dependent HVAC load.

Table 6-42: Shell Rebate Measure Average Annual Usage

Model Term	Pre-Retrofit Coefficient	Multiplier	Annual Usage (kWh)
Base Load (kWh/day)	20.04	365 (days)	7,513 (57.7%)
Daily kWh per CDD	1.77	379 (Spokane CDD)	700 (5.4%)
Daily kWh per HDD	0.75	6,707 (Spokane HDD)	4,808 (36.9%)
AVERAGE ANNUAL KWH PER SHELL REBATE PARTICIPANT			**13,021**

Savings from shell improvements should be realized almost exclusively through reductions in heating and cooling usage within participating homes. When the average reported savings claim of 1,406 kWh across the 767 homes analyzed is compared to this estimate of end-use load shares, we see that the program is claiming a (1,406/5,508) = 25.5% reduction in HVAC loads. The evaluation team recommends Avista examine planning assumptions about per-home consumption, end-use load shares, and percent reductions in heating and cooling loads from shell improvements. It may be that the percent reduction assumptions are sound, but they are being applied to an overstated assumption of the average electric HVAC consumption per home.

6.8.5 Program Results

As noted in section 6.8.2, the evaluation team found several significant outliers in Avista's reported data during the database review for the Shell program. In addition, during the document audit activities, the evaluation team also found that reported savings values did not match the project documentation for the majority of the sampled homes that had window replacement from single pane measures (such as size of window installed and baseline measure). In addition, the document audit activities found several discrepancies in the heating fuel type reported for the home and the associated fuel type that the measure is savings. For example, in a few instances, both the customer survey and the project application state wood and natural gas as the primary heating source, but the window and attic insulation incentives were paid based on electric heating. Based on these findings, the evaluation team recommends that Avista work with local contractors to confirm that the measure savings is tied to the correct heating fuel source, perhaps conducting verification activities on a percent of applications received would also help improve the reporting accuracy.

The electric realization rate for the Shell program is 38%. This program level realization rate was developed by taking a weighted average of the realization rates of the program measures shown in Table 6-43. The relative precision of the program level electric realization rate is ±33.1% at the 90% confidence level.

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Table 6-43: Shell Program Gross Verified Savings

Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Attic Insulation	45	46,172	46,172	38%	17,630
Floor Insulation	12	17,946	17,946	38%	6,852
Wall Insulation	17	35,948	35,948	38%	13,726
Window Replacement from Single Pane	146	505,897	505,897	38%	193,168
Window Replacement from Double Pane	150	297,701	297,701	38%	113,672
TOTAL	**370**	**903,663**	**903,663**	**38%**	**345,048**

6.9 Opower Behavioral Program

6.9.1 Overview

Home Energy Report (HER) programs have been widely shown to obtain savings through reduced energy consumption among households that receive them. Avista's Behavioral program relies on normative comparisons of energy usage to similar homes to increase awareness of energy consumption levels and stimulate recipients to alter their behavior and consume less energy. The evaluation approach relies on a combination of large sample sizes and random assignment to enable straightforward quantification of associated energy savings.

HERs provide residential customers with detailed information about how their home uses energy and includes charts that compare their energy use to that of similar homes. Participants receive up to eight home energy reports annually.

The program launched in June 2013 towards the end of the previous biennium. Avista assumed a three year measure life for savings reported in the 2012-2013 biennium so all program achievements in the 2014-2015 biennium were incremental to the 2,870,905 kWh reported by the program in the previous biennium. Due to a change in billing system, reports were suspended and none were sent out from February to August of 2015. Reports were reinstated in September 2015; however there was concern about how the gap in reports may affect savings given the incremental accounting of savings net of the previous biennium's achievements.

Like all of Avista's Idaho DSM offerings, the Opower Behavioral program is operated as an "electric only" program with the HER messaging designed to stimulate electric conservation among recipient homes. Because of this, Opower calculated reported savings only on electricity (kWh usage), and not on gas (therm) usage. Nexant also requested and analyzed the gas consumption records of treatment and control group homes who receive natural gas service

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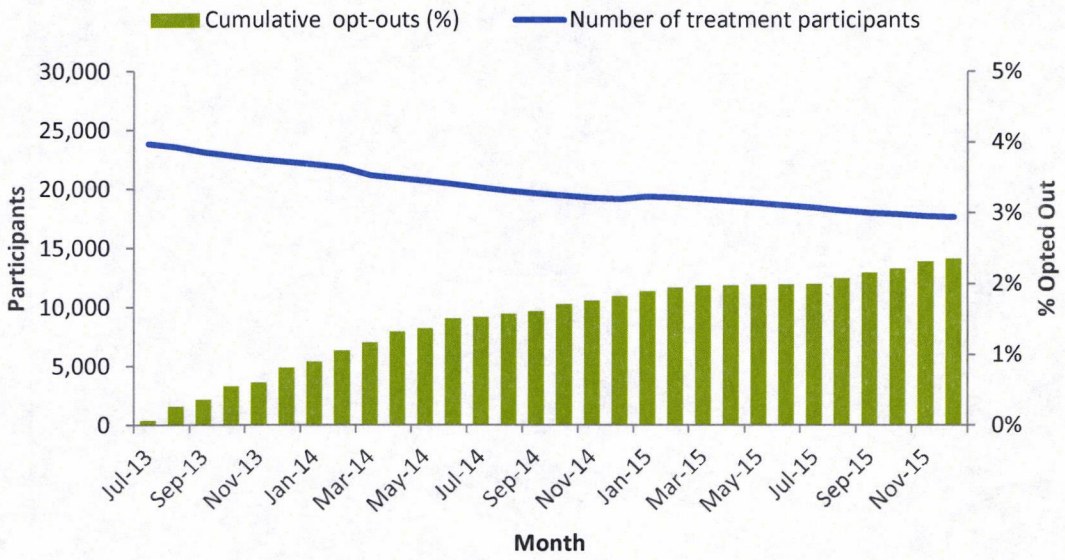
from Avista to assess whether the program produced statistically significant reductions in gas usage.

6.9.2 Program Achievements and Participation Summary

In Idaho, approximately 25,200 treatment and 13,000 control participants were randomly enrolled in the Behavioral Program. The Opower program is set up as an "opt-out" program, not an "opt-in" program, meaning that while households are randomly selected to receive the home energy report, they can also choose to opt out. Figure 6-133 presents the number of treatment participants and the opt-outs as a cumulative percentage by month in the post-period. The dip in participants observed in 2015 is most likely a legacy of Avista switching its billing system around that time. Approximately 2%[26] of homes opted out of the program.

Figure 6-13: Participation and Cumulative Opt-outs by Month



6.9.3 Methodology

6.9.3.1 Data Sources and Management

To develop estimates of the electric savings attributable to Avista's Behavioral Program, the evaluation team requested data covering two core components:

1) Participation Record: A list of all billing accounts that are part of the initiative, treatment\control designation, date assigned, opt-out or move-out data if applicable, and any demographic or rate code status information available in Avista's customer information system.

2) Consumption History: Monthly electric and gas billing records for each account in the treatment and control group including the meter read date and number of days

[26] 543 opt-outs from a total of 25,200 treatment group homes

in the billing period. Billing history was requested back to February 2012 to ensure adequate pre-treatment data for the analysis.

In preparation for the impact analysis, Nexant combined and cleaned the billing data provided by Avista. The dataset included 38,185 distinct accounts, 25,191 of which were assigned to the treatment group and 12,994 of which were assigned to the control group. The billing history dataset included 1,494,134 monthly billing records.

Nexant removed the following data points and customers from the analysis:

- 3 accounts with duplicate billing data.
- 2,023 accounts that had no billing data after program launch
- 3,064 accounts that lacked 12 months of billing data in the pre-period (March 2012-June 2013). Less than 12 months of pre-treatment data is insufficient for the analysis.

For the participation numbers used to calculate the aggregate impacts for each program month, the number of treatment participants was the number of unique treatment accounts with billing data that month, before accounts with no post data and accounts with insufficient pre-data were removed. Treatment group homes that opted out of the program were not removed from the impact analysis or the participation counts. While this may seem counterintuitive, it is necessary to preserve the integrity of the RCT design because control group homes do not have the option to opt-out and there is no way to determine which control group homes would opt-out if they were assigned to treatment. This approach dilutes the per-home impacts to some extent because only ~ 98% of the participants were actively receiving HERs at a given time, but this is negated by including all active accounts in the estimation of aggregate impacts.

Like most utilities, Avista does not bill its customers for usage within a standard calendar month interval. Instead, billing cycles are a function of meter read dates and vary across accounts. Since the interval between meter reads vary by customer and by month, the evaluation team "calendarized" the usage data to reflect each calendar month, so that all accounts represent usage on a uniform basis. The calendarization process includes expanding usage data to daily usage, splitting the bill month's usage uniformly among the days between reads. The average daily usage for each calendar month is then calculated, by taking the average of usage within the calendar month.

A similar calendarization process was performed on the gas billing data. However, instead of cleaning individual accounts with bad data, we matched up the accounts with valid electric billing data to the accounts in the gas billing data and only used those accounts that were also in the cleaned electric data.

6.9.3.2 Equivalence Testing

The next step in the evaluation team's analysis approach was to perform a detailed review of the assignment randomization by comparing consumption patterns for the treatment and control group for the months in the pre-period (March 2012 to June 2013). The purpose of this analysis

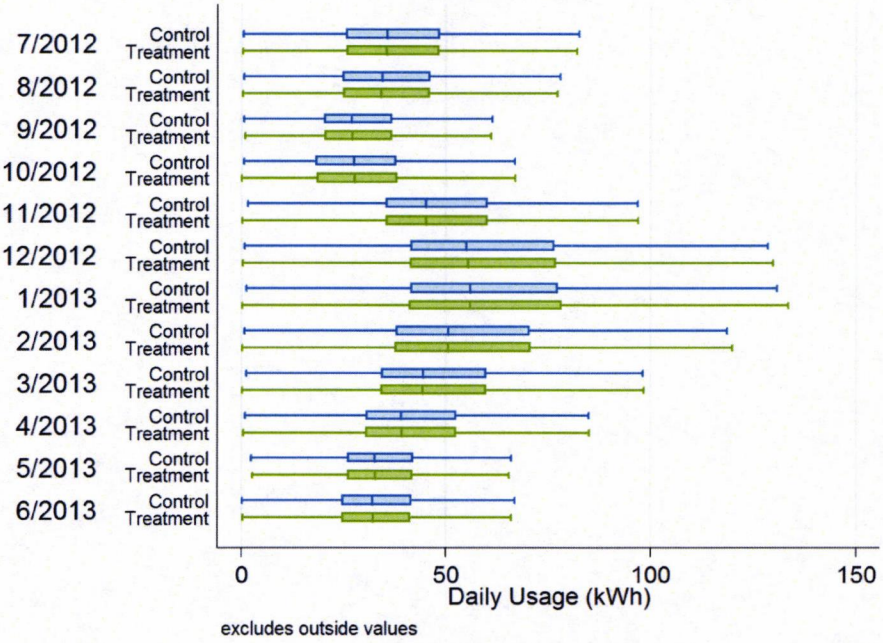
is to determine if structural differences in electricity consumption existed between the treatment and control group prior to HER exposure. Pre-treatment differences can take the form of total annual consumption or variation in the seasonality of consumption. The findings of this step are of critical importance because they will determine the appropriate model specification to estimate savings. Table 6-4444 displays the results of a difference in means two-sided t-test to validate the randomization and confirms that there is no significant difference in usage between the treatment and control groups in the pre-period. The results confirm that the randomization is robust and that there is no real difference in the energy consumption of the two groups.

Table 6-44: Difference in Means t-test Values

Control Average Daily Usage: Pre period	Treatment Average Daily Usage: Pre period	Critical Value (t)	P-value (95%)
43.51	43.47	.59	.55

Figure 6-14 examines usage in the pre-treatment visually and echoes the results of the statistical test.

Figure 6-14: Treatment and Control Energy Usage in the Pre-Period



6.9.3.3 Regression Analysis

The evaluation team used a lagged dependent variable (LDV) model to estimate savings. The LDV model is the preferred analysis approach to use when the randomization of homes to treatment and control is sound and results in groups with equivalent usage prior to HER exposure, as presented in the section above. If pre-assignment differences in electric

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consumption are present, a linear fixed effects regression model (LFER) would have been the more appropriate model.

The LDV model is a category of specifications in which the dependent variable in the equation is restricted to the post-test period. The customers' usage prior to the onset of treatment for the same period (i.e., usage in the same monthly period in the prior year) is entered into the regression model as an independent variable – thus the name lagged dependent variable model – and the coefficient for the treatment variable is interpreted as the change in consumption due to treatment. The specification used is shown in Equation 6-7 and the corresponding variables are defined in Table 6-45.

Equation 6-7: Lagged Dependent Variable Model Specification

$$kWh_{ity} = \beta_0 + \sum_{t=1}^{12}\sum_{y=1}^{n} I_{ty} * \beta_{ty} + kWh_{i,t,y-n} * \beta_{t,y-n} + \tau * treatment_i * I_{ty} + \varepsilon_{it}$$

Table 6-45: Lagged Dependent Variable Model Definition of Terms

Variable	Definition
β_0	The intercept, or the coefficient on the billing month t, post-period year indicator variable that is left out due to collinearity
kWh_{ity}	Customer i's average daily energy usage in billing month t of the post-period y
I_{ty}	Indicator variable that equals one for each monthly billing period t, post-period y and zero otherwise.
β_{ty}	The coefficient on the billing month t, post-period year indicator variable
$kWh_{i,t,y-n}$	The lagged usage of customer i in the corresponding billing month t, in the pre-period y-n
$\beta_{t,y-n}$	The coefficient for the corresponding billing month t, in the pre-period y-n
$treatment_i$	Treatment variable, equal to one if customer i is in the treatment group and zero if control
τ	Estimated average daily energy reduction of the treatment group in bill month t for the post-period y
ε_{it}	Error term for customer i for bill month t

The average daily treatment effect (τ) for each billing period of the study is multiplied by number of active customers in the treatment group times the number of days in that month to estimate the monthly aggregate savings (MWh). The monthly savings impacts are summed over the study horizon to produce the total change in energy consumption in treated homes over the period under study. The results of an overlap analysis discussed below are then subtracted from this total change in consumption to arrive at the net ex post energy savings attributable to the Behavioral Program.

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6.9.3.4 Overlap Analysis

The ability to serve as a marketing tool for other energy efficiency initiatives is an important part of what makes normative comparison reports so attractive to utilities and agencies. The billing analysis methodology captures all savings at the meter, even those claimed by other programs. To the extent that the treatment and control group participate in other Avista programs at a different rate, the difference in kWh needs to be netted off of the Behavioral Program impact to prevent any double-counting or under-statement of savings. For measures promoted by Avista and tracked at the customer level, the amount of savings overlap was estimated by matching the treatment and control group customers to the energy efficiency program participation data. Next, the difference between treatment and control groups in rebated savings per home is calculated and the difference multiplied by the number of treatment group homes.

6.9.4 Findings and Recommendations

6.9.4.1 Per-Home kWh and Percent Impacts

The evaluation team estimates the average home in the Opower Behavioral Program saved over 579 kWh of electricity from January 2014 through December 2015. This represents a 1.81% reduction in total electric consumption compared to the control group over the same period. The 579 kWh and 1.81% impact estimates include HER savings net of savings from incremental participation in other Avista Energy Efficiency programs. As explained in Section 6.9.3.4, an overlap analysis was performed to prevent double-counting of savings that have already been attributed to another energy-saving program. The overlap analysis found that treatment group homes participated in energy efficiency programs at a greater rate than the control group, necessitating a downward adjustment of the impacts. This means a net decrease in usage for the Opower Behavioral Program when comparing the treatment to the control. Therefore, a downward adjustment was applied to each monthly savings estimate based on differential energy efficiency participation and the greater per-home EE savings for the treatment group. The dual participation adjustment totaled 1.35 kWh over the 24 month period of analysis.

Table 6-46 shows the LDV impact estimates in each month for the average treatment household, totaling 580 kWh over the biennium. The table also shows the program savings after subsequent adjustment for savings attributed the energy efficiency overlap, totaling 579 kWh per household over the biennium.

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Table 6-46: Opower Behavioral Program Impact Estimates with EE Adjustments

Month	Treatment participants	kWh impact per customer	kWh impact from EE overlap	kWh savings per treated home	MWh savings
Jan-14	22,122	26.89	-0.13	27.02	598
Feb-14	21,846	24.55	-0.24	24.79	542
Mar-14	21,176	18.52	-0.22	18.74	397
Apr-14	20,953	15.57	-0.19	15.76	330
May-14	20,708	13.80	-0.27	14.08	291
Jun-14	20,430	15.07	-0.28	15.35	314
Jul-14	20,138	22.76	-0.19	22.95	462
Aug-14	19,845	19.52	-0.20	19.72	391
Sep-14	19,651	16.56	-0.23	16.79	330
Oct-14	19,447	22.58	-0.26	22.84	444
Nov-14	19,248	30.91	-0.21	31.12	599
Dec-14	19,157	41.28	-0.09	41.37	792
Jan-15	19,366	33.08	-0.07	33.15	642
Feb-15	19,296	26.86	-0.33	27.20	525
Mar-15	19,158	21.32	-0.33	21.65	415
Apr-15	19,001	19.89	-0.04	19.93	379
May-15	18,818	17.42	0.69	16.73	315
Jun-15	18,635	20.28	0.38	19.90	371
Jul-15	18,419	18.94	0.59	18.35	338
Aug-15	18,189	19.29	0.50	18.80	342
Sep-15	18,021	18.76	0.29	18.47	333
Oct-15	17,869	27.23	0.36	26.87	480
Nov-15	17,726	36.40	0.81	35.59	631
Dec-15	17,635	52.91	1.00	51.92	916
Biennium Total		**580.42**	**1.35**	**579.08**	**11,176**

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6.9.4.2 Aggregate Impacts

The total impact of the Opower Behavioral Program is calculated by multiplying the per-home impacts (adjusted for incremental EE participation) for each calendar month by the number of treatment group homes in that month. Over the twenty-four month period examined by the evaluation team in this evaluation, participants saved 11,176 MWh of electricity. The monthly and annualized aggregate savings are shown in Table 6-46.

Because some of the savings observed in the 2014-2015 biennium were already claimed in the previous biennium due to the assumed measure life of 3 years, these previous achievements must be netted out to calculate incremental achievements and prevent double-counting. Table 6-47 displays the aggregate savings in 2014 and 2015, respectively, net of savings counted in the previous year.

Table 6-47: Opower Program Incremental Annual MWh Savings

Year	Reported MWh impact (cumulative)	Verified MWh impact (cumulative)	Incremental MWh
2013	3,184	2,871	0
2014	5,668	5,491	2,620
2015	5,930	5,685	195
BIENNIUM TOTAL			**2,814**

6.9.4.3 Precision of Findings

The margin of error of the impact estimates are also important to consider. If margin of error is wide, the true savings value could actually differ from the point estimates by a large amount. The margin of error for the per-home biennium impact estimate is ± 38 kWh at the 90% confidence level. Table 6-48 presents the upper and lower bounds of the 90% confidence interval for biennium per-home kWh savings, percent reduction, and aggregate impact estimates.

Table 6-48: Confidence Intervals Associated with Behavioral Program Impact Estimates

Parameter	Lower Bound (90%)	Point Estimate	Upper Bound (90%)
2014–2015 Program Savings per Home	541 kWh	579 kWh	617 kWh
Percent Reduction	1.70%	1.81%	1.93%
Aggregate Impact	10,442 MWh	11,176 MWh	11,910 MWh

The impact estimate has an absolute precision of ± 0.12% and a relative precision of ± 6.6% at the 90% confidence interval. The estimates are statistically significant, as the confidence interval does not include zero. Figure 6-15 shows the monthly savings estimates with relative

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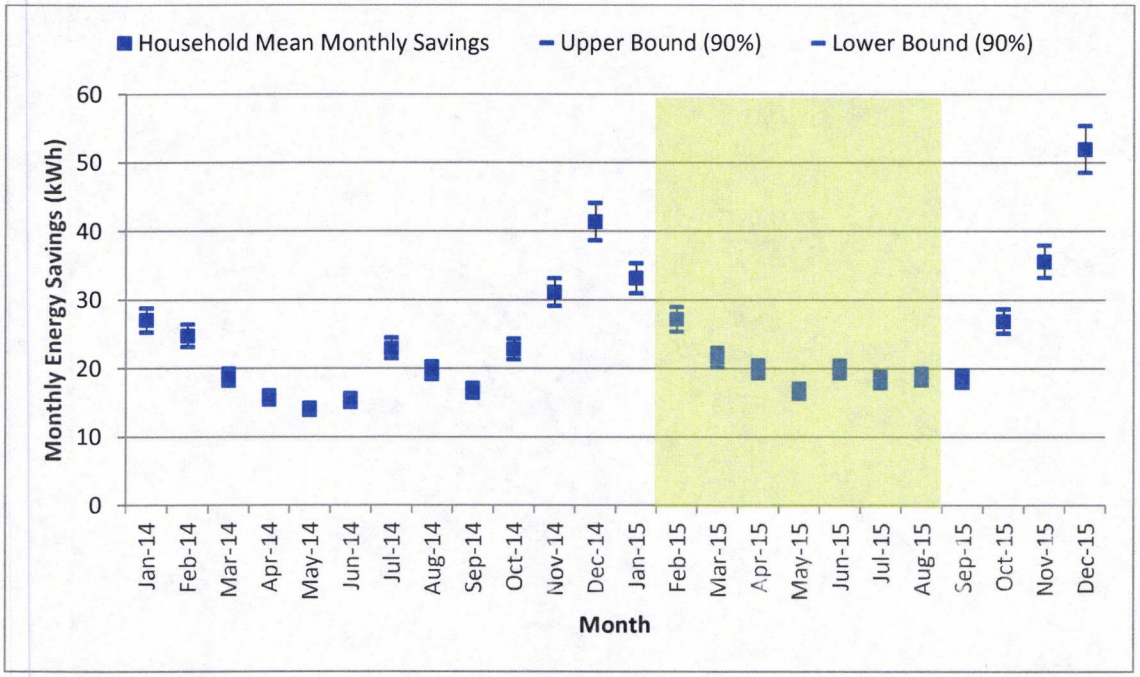
precision upper and lower bounds. The shaded box denotes the period between February and August 2015 where reports were not being sent out.

Figure 6-15: Average Monthly Savings per Household with Relative Precision Bounds



6.9.4.4 Savings Patterns

Avista currently mails out reports to the treatment group on a varying cycle, with participants receiving 8 reports annually. The blue series in Figure 6-16 depicts the estimated percent reduction for each month of the treatment period, July 2013 through December 2015. Figure 6-16 also shows the average daily kWh usage of the control group with a green line. The control group's average daily usage shows highest electricity usage in the winter months.

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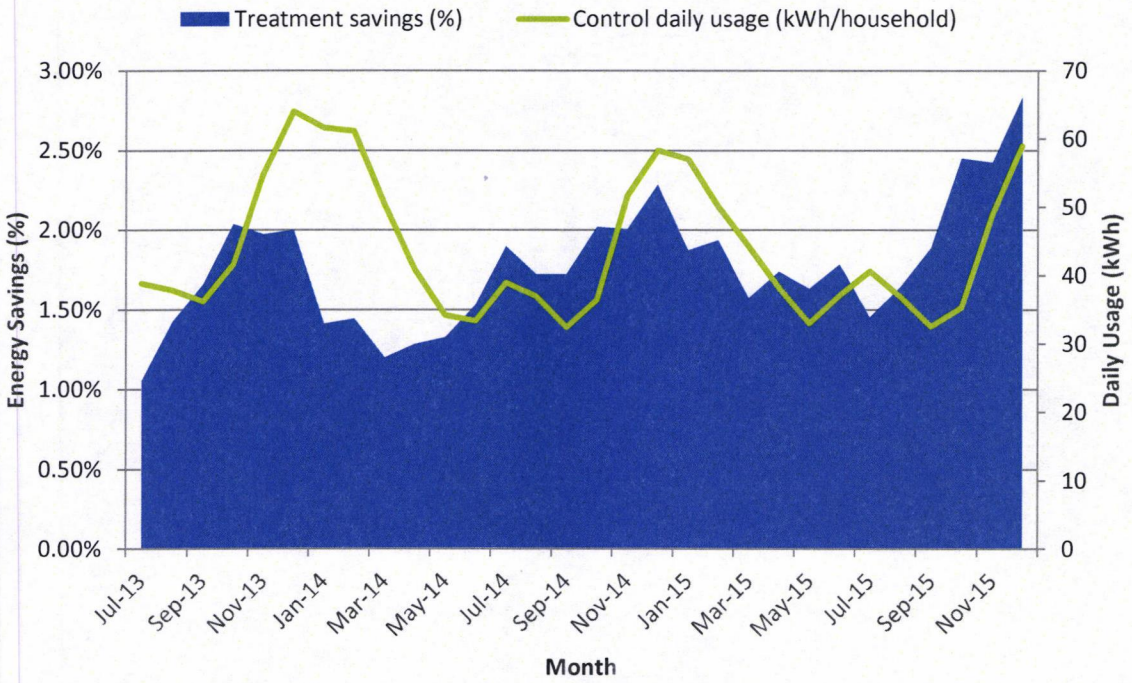
Figure 6-16: Average Percent Savings and Control Daily Usage by Month



There is a seasonal pattern to the savings, where the greatest savings are experienced during the winter months. It is unusual to see the highest savings on a percent basis when usage is also peaking. However, we can see roughly the same pattern on an absolute basis in Figure 6-15. Additionally, the significant gas savings during the winter months, which are discussed in more depth in Section 6.9.4.5, mean that the electricity savings are not entirely offset by an increase in gas usage. The Opower reports can encourage fuel switching as a way of reducing electricity usage.

It is important to note what is happening during the period of February to August of 2015, when home energy reports were not being sent out to customers. The monthly savings by year are shown in Figure 6-17. With the exception of July and August, each month's estimated savings grows from 2014 to 2015. It is also important to note that the savings during this period hold fairly consistent with what was observed in the year before, meaning they do not grow, but do not diminish significantly either. Additionally, once reports resume in September 2015, monthly savings surpass what they were in the years previous again.

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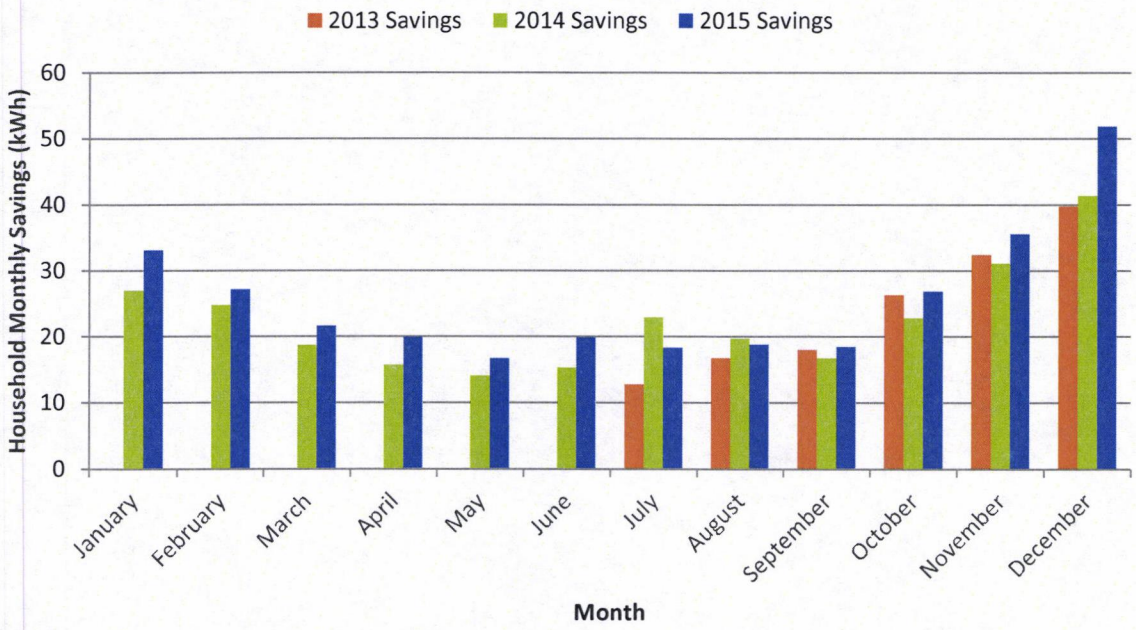
Figure 6-17: Household Monthly Savings by Year



6.9.4.5 Gas Savings

While the Behavioral Program set up by Avista and Opower is an electricity-saving program, Avista is a gas and electric utility and approximately 45% of the homes in Idaho assigned to the program also receive natural gas service from Avista. The evaluation team used the LDV model to examine any gas usage differences created by the program. In addition to general conservation messaging, the Behavioral Program provided information on the benefits of fuel switching (electric->gas). Although fuel switching impacts would be captured by the overlap analysis if the switch was rebated by Avista, these interventions would have opposite effects, so we entered the analysis without a hypothesis about whether gas reductions, increases, or no effect at all would be found.

The results of the gas impact analysis with overlap analysis adjustments are summarized by month in Table 6-49. While in certain months, a net increase in usage is observed in the program participants, over the two year program period a net savings of 8.48 therms per household is estimated. Program-wide, gas savings during the 2014-2015 biennium totaled 74,579 therms. Figure 6-18 displays the monthly gas savings estimates with relative precision bounds. The shaded box represents the period between February and August 2015 when no reports were sent out.

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Table 6-49: Opower Program Gas Impact Estimates with EE Adjustments

Average Number of Participants in Biennium	Biennium Gas Savings per Customer	Therms Impact from EE Overlap	Biennium Gas Savings per Treated Home (with EE Overlap)	Aggregate Therms Savings
8,588	8.56	.08	4.48	74,579

The margin of error for the per-home biennium impact estimate is ± 6.0 therms at the 90% confidence level. Table 6-50 displays the point estimates and the 90% confidence interval upper and lower bounds for the biennial per home, percent, and aggregate gas savings estimates. The impact estimate has an absolute precision of ± 0.43% and a relative precision of ± 71% at the 90% confidence interval.

Table 6-50: Confidence Intervals Associated with Program Gas Impact Estimates

Parameter	Lower Bound (90%)	Point Estimate	Upper Bound (90%)
Biannium Savings per Home	2 therms	8 therms	15 therms
Percent Reduction	0.18%	0.61%	1.04%
Aggregate Impact	21.540 therms	74.579 therms	127619 therms

In the summer months, the estimated savings are low and in the case of August and September of 2014, are slightly negative. However, it is important to note that despite the monthly fluctuations in gas savings illustrated in Figure 6-18, the estimated gas savings are statistically significant over the biennium[27].

[27] t = -2.91, P-value = 0.004

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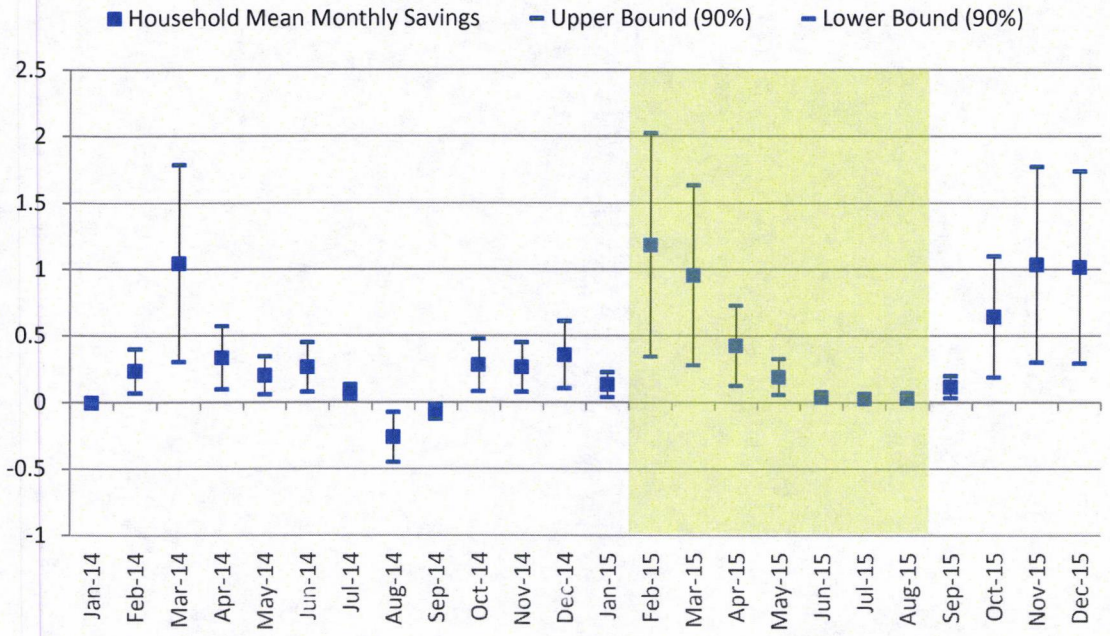
Figure 6-18: Average Monthly Gas Savings per Household with Relative Precision Bounds



6.10 Low Income

6.10.1 Overview

Avista's electric Low Income program offers a variety of conservation and fuel efficiency measures to low income households. Avista leverages Community Action Program (CAP) agencies to deliver energy efficiency programs to the Company's low income customer group. CAP agencies have resources to income qualify, prioritize and treat homes based upon a number of characteristics. In addition to the Company's annual funding, the Agencies have other monetary resources that they can usually leverage when treating a home with weatherization and other energy efficiency measures. The Agencies either have in-house or contractor crews to install many of the efficiency measures of the program. Avista provides CAP agencies with an "Approved Measure List" of energy efficiency measures. Any measure installed on this list by the Agency in an income qualified home will receive 100% reimbursement for the cost for the work.

6.10.2 Program Achievements and Participation Summary

Participation in the 2014-2015 Low Income program totaled 7,302 conservation and fuel conversion projects. Table 6-51 summarizes the reported participation counts and energy savings for the measures that make-up the Low Income program. Figure 6-19 presents the energy savings for non-lighting conservation measures, lighting conservation measures, and the fuel conversion measures. Non-lighting conservation measures account for 46% of the program

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savings, with duct sealing and insulation measures accounting for 75% of this category, as shown in Figure 6-20.

Table 6-51: 2014–2015 Low-Income Program Reported Participation and Savings

Measure Category	Measure	2014–2015 Reported Participation Count	2014–2015 Reported Savings (kWh)
Non-Lighting Conservation	Insulation	164	128,525
Non-Lighting Conservation	ENERGY STAR Windows	53	1,418
Non-Lighting Conservation	ENERGY STAR Doors	60	17,241
Non-Lighting Conservation	Air Infiltration	113	58,337
Non-Lighting Conservation	Duct Sealing	97	132,290
Non-Lighting Conservation	ENERGY STAR Refrigerator	14	11,284
Non-Lighting Conservation	Water Heater	1	107
Non-Lighting Conservation	E to G Furnace Conversion	77	195,948
Fuel Conversion	E to G Water Heat Conversion	60	71,421
Fuel Conversion	E to G Heatpump Conversion	14	41,930
Lighting Conservation	LI Giveaway CFL bulbs	4,526	72,855
Lighting Conservation	LI Giveaway LED bulbs	2,123	27,599
TOTAL		**7,302**	**758,955**

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Figure 6-19: 2014-2015 Low Income Program Reported Energy Saving Shares: Measure Category

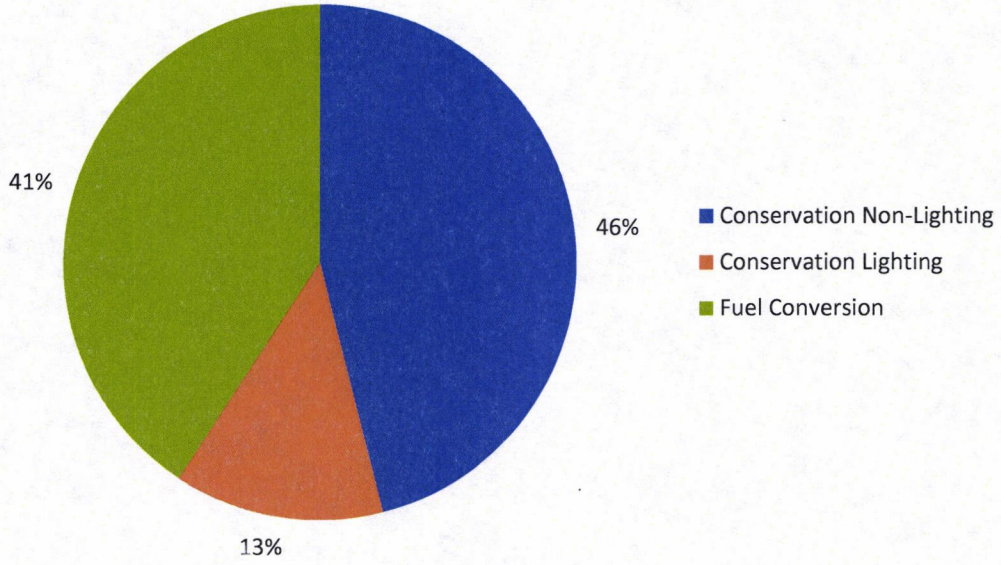

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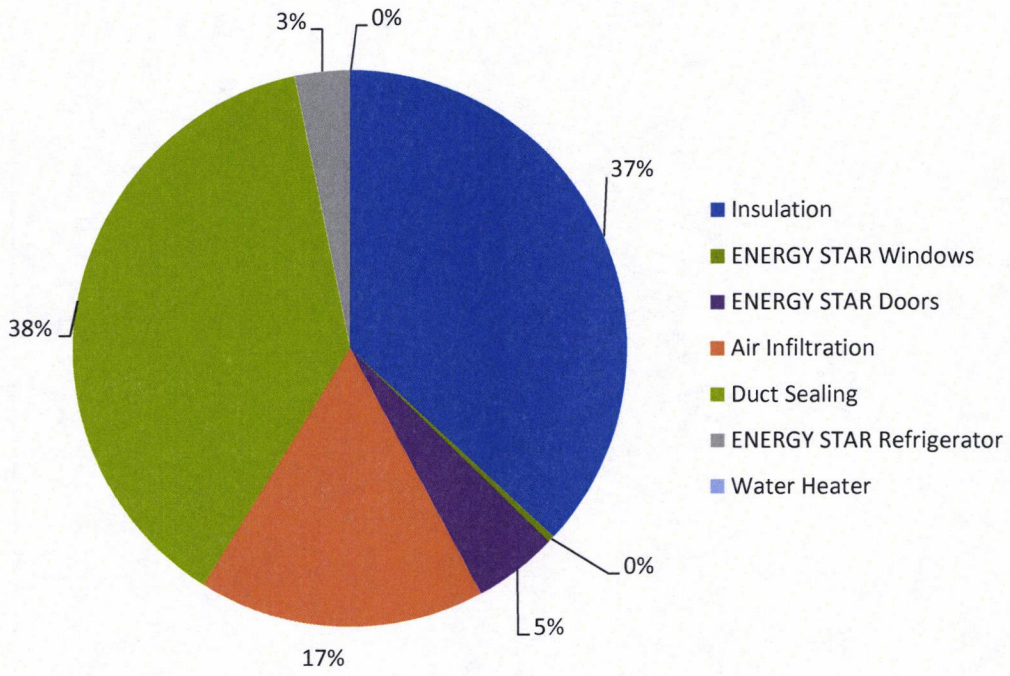
Figure 6-20: 2014-2015 Low-Income Program Reported Energy Saving Shares: Non-Lighting Conservation



6.10.3 Methodology

The evaluation team organized the analysis for the Low Income Program based on the measures categories noted in Table 6-51 above. For the non-lighting conservation and fuel conversion measures, the evaluation team employed a regression analysis. For the lighting conservation measures, the evaluation team followed the same methodology as outlined in the Residential Lighting Section (Section 6.7.3). The remainder of this section outlines the methodology for the non-lighting conservation and fuel conversion measures.

The Low Income program operates as an electric-only program in Idaho with CAP Agencies targeting electric savings opportunities. Participating homes generally received multiple improvements so the electric savings values from all measures installed within a given home were aggregated to arrive at the total reported savings for each home. The evaluation team relied on a regression analysis of Avista billing data to estimate per-home impacts. Billing analysis was determined to be an appropriate method because the average annual electric savings claimed per participating home was almost 2,300 kWh across the 323 treated homes.

Next, homes were assigned to one of two groups for analysis:

1) **Electric Conservation Homes** – these homes had reported electric savings

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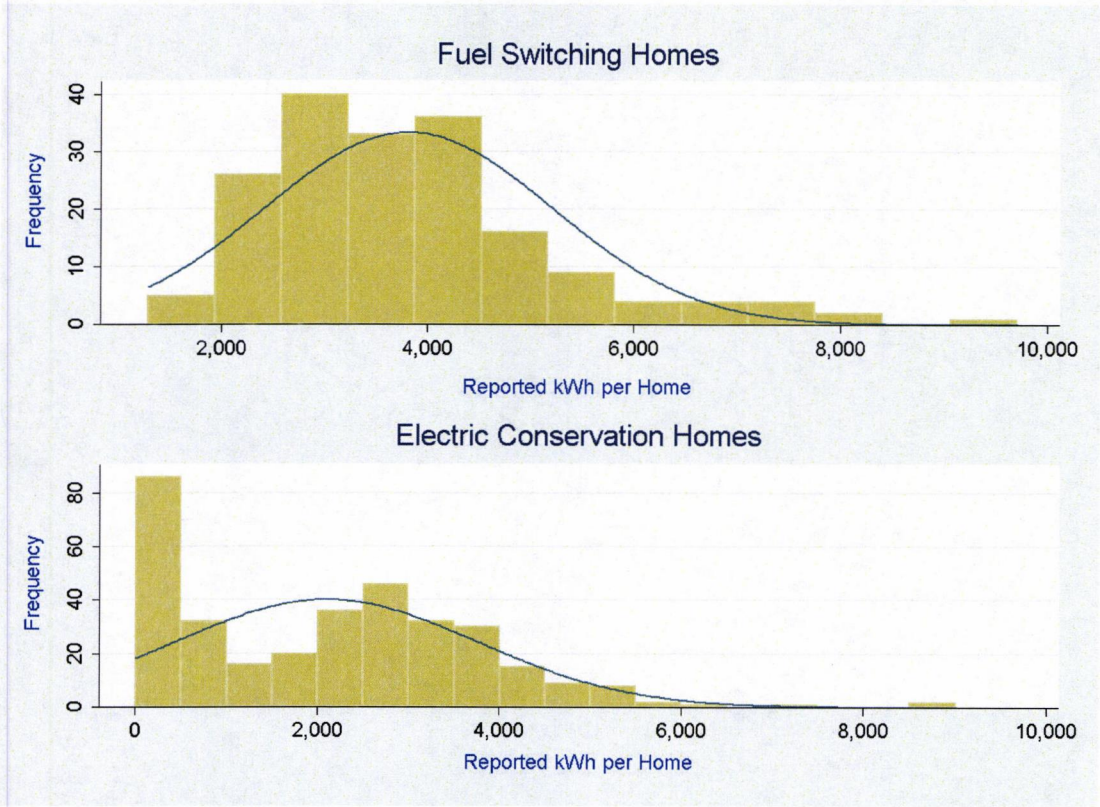
2) **Fuel Conversion Homes** – these homes had reported electric savings and a *negative* reported therm savings. This net gas penalty (and a large share of the electric savings) resulted from a conversion of the homes heating or water heating system from electricity to natural gas.

Figure 6-21 shows the distribution of per-home reported electric savings for the two groups. Reported electric Impacts for the fuel switching homes were generally larger. Within the Electric Conservation Homes there was a subset of residences that reported limited electric savings because the primary improvements affected the gas heating system.

Figure 6-21: Distribution of Reported kWh Values by Home Type



As described in Section 3.4.4, each home was matched to nearest weather station and historical weather records were merged with historical consumption. Homes were required to have at least 12 months of pre-retrofit and 12 months of post-retrofit billing data for inclusion in the analysis. The evaluation team used a fixed effects panel regression model to establish the average relationship between electric consumption and weather before and after service. Separate models were estimated for fuel conversion homes and electric conservation homes and both Idaho and Washington homes were used in the analysis to boost the precision of the results. Regression coefficients were then applied to normal weather conditions (TMY3) for the region to estimate weather-normalized annual electric savings. The regression coefficients and relevant goodness of fit statistics are presented in Appendix C.

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The evaluation team also conducted a review of Avista's 2014 and 2015 tracking databases and a document audit on 24 projects.

6.10.4 Findings and Recommendations

6.10.4.1 Non-Lighting Conservation and Fuel Conversion Homes

Table 6-52 summarizes the key inputs and outputs of the regression analysis. As expected the fuel switching homes saved significantly more electricity on average than homes that did not have a primary mechanical system converted from electricity to natural gas. The average percent reduction in electric consumption for the 67 fuel switching homes analyzed was 55.7%, meaning the post-retrofit electric consumption was less than half of what it was pre-retrofit. Electric conservation homes used less electricity on average pre-retrofit than fuel switching homes (13,278 kWh vs. 17,722 kWh). This group saved less on both an absolute and percent basis.

Table 6-52: Low Income Billing Analysis Findings

Stratum	Fuel Conversion Homes	Electric Conservation Homes
Number of Homes Analyzed	67	165
Average Reported kWh per Home	3,909	1,233
Weather Normalized Annual kWh Pre-Retrofit	17,722	13,278
Weather Normalized Annual kWh Post-Retrofit	7,846	12,575
Average kWh Savings per Home	9,876	702
Realization Rate	253%	57%
Relative Precision (90% confidence level)	± 9.2%	± 60.9%
Average Percent Reduction in Annual Electric Consumption	55.7%	5.3%

The realization rate for Fuel Conversion Homes was 253%, with homes saving an average of almost 10,000 kWh annually. It is worth noting that the reported savings assumptions for electric to gas conversion of heating and water heating in Low Income program were far more conservative than the Fuel Efficiency program, which assumed 12,012 kWh for furnace conversions and 4,031 kWh for water heater conversions. Evaluation results actually found a higher per home impact from fuel switching in the Low Income program than in Fuel Efficiency program although the difference was not statistically significant. Moving forward, the evaluation team recommends that Avista align assumptions for fuel switching savings for the Low Income and Fuel Efficiency programs.

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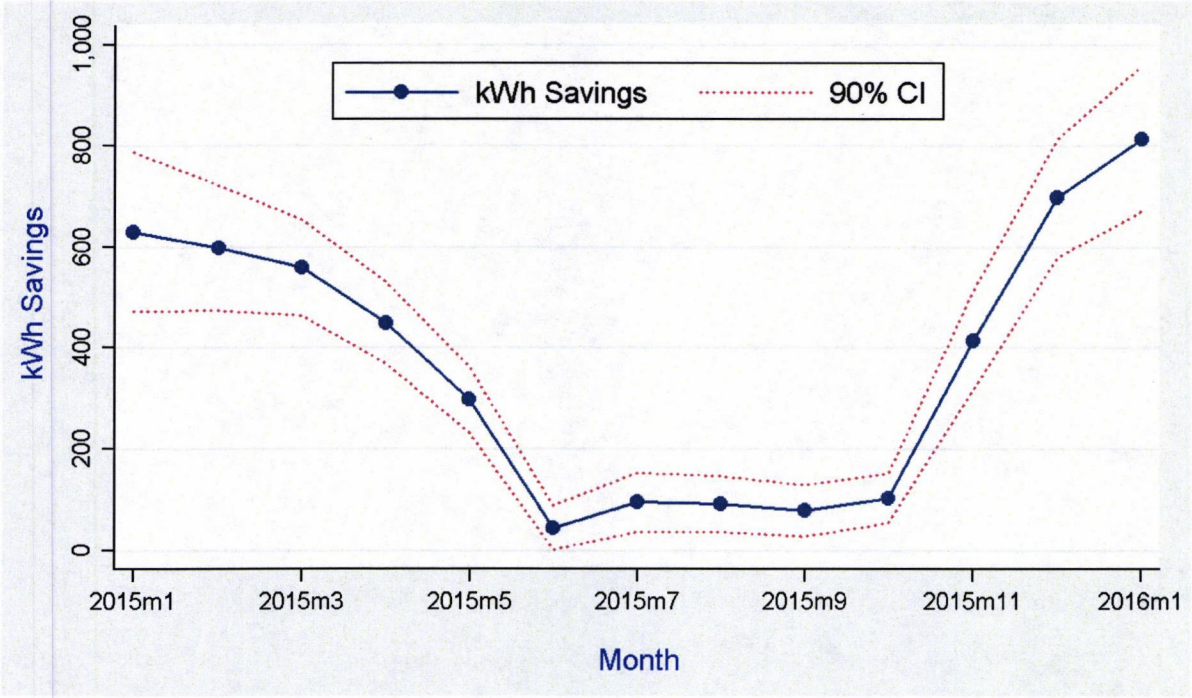
Figure 6-22 shows the evaluation teams estimates of the average Low Income home savings by month for the last 13 months. Savings from the Low Income program are occurring primarily during winter months when electric heating loads are highest. Figure 6-22 was created by comparing the actual metered loads of homes (both fuel conversion and electric conservation) to the regression estimates of what consumption would have been during the pre-retrofit period using the actual weather conditions in place January 2015 through January 2016.

Figure 6-22: Low-Income Program Impacts by Month



6.10.4.2 Lighting Conservation

The 2014 and 2015 Low Income programs CAP agencies conducted multiple "giveaway" events throughout the program cycle and reported bulb type (CFL/LED) and bulb count for each of the events and the location of the event so that Avista could allocate the savings attributable to their Washington and Idaho service territories. Based on the program reported data, the average kWh savings attributed to the CFL bulbs was 16.1 kWh and 12.5 kWh for LEDs. Based on the methodology outlined in Section 6.7.3 above, the evaluation team estimates the average savings for the giveaway CFLs to be 18.7 kWhs and 20.9 kWhs for LEDs (assuming a 60w equivalent). Table 6-53 presents the realization rate and per-unit gross verified savings.

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Table 6-53: Low-Income Lighting Conservation Measures Gross Verified Savings

Bulb Type	Average Reported Savings (kWh/bulb)	Realization Rate	Gross Verified Savings (kWh/bulb)
CFL Giveway	16.1	116%	18.7
LED Giveaway	12.5	167%	20.9

6.10.5 Program Results

The database review and document audit activities conducted by the evaluation team did not result in any adjustments to the reported Avista savings values. The overall electric realization rate for the Low Income program was 147%. This program level realization rate was developed by taking a weighted average of the realization rates of the measure types shown in Table 6-54. The relative precision of the program level electric realization rate was ±12.6% at the 90% confidence level.

Table 6-54: Low-Income Program Gross Verified Savings

Measure Category	2014–2015 Reported Participation Count	2014–2015 Adjusted Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)
Conservation Non-Lighting	502	349,202	57%	199,045
Conservation Lighting	6,649	100,454	130%	130,730
Fuel Conversion	151	309,299	253%	782,526
TOTAL	**7,302**	**758,955**	**147%**	**1,112,301**

6.11 Residential Sector Results Summary

Table 6-55 lists the gross verified savings for each of Avista's residential programs in Idaho in 2014 and 2015 and for the overall portfolio. The Idaho electric residential sector achieved a 99% realization rate and the relative precision of the program-level electric realization rate was ±9.05% at the 90% confidence level

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Table 6-55: Residential Program Gross Impact Evaluation Results

Program	2014-2015 Reported Savings (kWh)	2014-2015 Adjusted Reported Savings (kWh)	Realization Rate	2014-2015 Gross Verified Savings
Appliance Recycling	261,924	250,920	166%	416,524
HVAC	872,828	872,828	60%	521,365
Water Heat	239,267	239,267	148%	354,675
ENERGY STAR Homes	140,538	140,538	123%	173,120
Fuel Efficiency	5,290,679	5,295,779	60%	3,198,893
Lighting	8,323,842	8,323,842	126%	10,457,288
Shell	903,663	903,663	38%	345,048
Opower	2,746,000	2,746,000	102%	2,814,601
Low Income	758,955	758,955	147%	1,112,301
TOTAL RESIDENTIAL	**19,537,696**	**19,531,792**	**99%**	**19,393,814**

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7 Conclusions and Recommendations

7.1 Summary

The following outlines the evaluation team's conclusions and recommendations for Avista to consider for future program processes and reporting. Additional details regarding the conclusions and recommendations outlined here can be found in the program-specific sections of this report.

7.2 Impact Findings

The evaluation team performed the impact evaluation for Avista's 2014 and 2015 Idaho electric program through a combination of document audits, customer surveys, engineering analysis and onsite measurement and verification (M&V) on a sample of participating projects. The impact evaluation activities resulted in a 97% realization rate across Avista's 2014-2015 portfolio of programs (Table 7-1). Table 7-3 and Table 7-2 summarize Avista's 2014 and 2015 impact evaluation results by sector and program.

Table 7-1: 2014-2015 Idaho Electric Portfolio Evaluation Results

Sector	Reported Savings (kWh)	Realization Rate (%)	Gross Verified Savings (kWh)
Residential	18,772,837	97%	18,281,513
Nonresidential	12,379,360	94%	11,687,224
Low Income	758,955	147%	1,112,301
PORTFOLIO	**31,911,152**	**97%**	**31,081,038**

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Table 7-2: Idaho Electric Nonresidential Program Evaluation Results

Program	2014-2015 Reported Savings (kWh)	Realization Rate	2014-2015 Verified Gross Savings (kWh)
EnergySmart Grocer	2,387,662	90%	2,138,035
Food Service Equipment	130,946	54%	70,971
Green Motors	43,954	54%	23,823
Motor Controls HVAC	466,340	54%	252,751
Commercial Water Heaters	190	54%	103
Prescriptive Lighting	3,475,049	99%	3,432,865
Prescriptive Shell	54,381	54%	29,474
Fleet Heat	7,228	54%	3,917
Site Specific	5,813,610	99%	5,735,284
TOTAL NONRESIDENTIAL	**12,379,360**	**94%**	**11,687,224**

Table 7-3: Idaho Electric Residential Program Evaluation Results

Program	2014-2015 Adjusted Reported Savings (kWh)	Realization Rate	2014-2015 Gross Verified Savings
Appliance Recycling	250,920	166%	416,524
HVAC	872,828	60%	521,365
Water Heat	239,267	148%	354,675
ENERGY STAR Homes	140,538	123%	173,120
Fuel Efficiency	5,295,779	60%	3,198,893
Lighting	8,323,842	126%	10,457,288
Shell	903,663	38%	345,048
Opower	2,746,000	102%	2,814,601
Low Income	758,955	147%	1,112,301
TOTAL RESIDENTIAL	**19,531,792**	**99%**	**19,393,814**

7.3 Conclusions and Recommendations

The following outlines the key conclusions and recommendations as a result of the evaluation activities. Specific details regarding the conclusions and recommendations outlined here, along with additional conclusions and recommendations can be found in the program-specific sections of this report.

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7.3.1 Nonresidential Programs

The overall realization rate for the nonresidential portfolio is 94%. The realization rates ranged from 99% for the Site Specific and Prescriptive Lighting programs down to 54% for the "Prescriptive Non-Lighting Other" program. The Site Specific and Prescriptive Lighting programs are the largest programs in the portfolio, together representing 75% of the portfolio's gross verified savings. The evaluation team found that the processes Avista is utilizing for estimating and reporting energy savings for the nonresidential programs are predominantly sound and reasonable. The following subsections outline specific conclusions and recommendations for several of the nonresidential programs.

7.3.1.1 Site Specific Program

Conclusion: The Site Specific program constitutes almost 50% of the program energy shares. Within the last 2 years, Avista has increased their level of quality assurance and review on projects that participate through the program. The evaluation team's analysis resulted in a 99% realization rate for the Site Specific program. The strong realization rate indicates that Avista's internal process for project review, savings estimation, and installation verification are working to produce high quality estimates of project impacts.

> **Recommendation**: The evaluation team recommends that Avista continue to operate this program with the current level of rigor. For interior lighting projects, Avista should consider applying the interactive factors deemed by the RTF to quantify the interactive effects between lighting retrofits and their associated HVAC systems. More specifically, for interior lighting projects, Avista assumes a standard interactive factor of 7.7% for buildings with air conditioning. The RTF's values for interactive factors vary depending on heating and cooling system types and building type. For some building types, especially those that tend to participate in the Site Specific program, the RTF's interactive factors are higher than Avista's factor

> **Recommendation**: While the impact from the Commercial Windows and Insulation measures under the Site Specific program are minimal, Avista should further review its algorithm for cooling season savings achieved by window replacements. The algorithm that Avista currently uses may be overstating the impacts of these replacements on air condition energy consumption.

7.3.1.2 Prescriptive Lighting Program

Conclusion: The Prescriptive Lighting program is the second largest program in Avista's nonresidential portfolio, constituting 28% of the energy savings. The evaluation team's analysis resulted in a 99% realization rate for the Prescriptive Lighting program, indicating that Avista's reported energy savings for this program are accurate.

> **Recommendation**: The evaluation team recommends that Avista continue to operate this program with the current level of rigor. Avista should consider applying the interactive factors deemed by the RTF to quantify the interactive effects between interior

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lighting retrofits and their associated HVAC systems. More specifically, for interior lighting projects, Avista assumes a standard interactive factor of 7.7% for buildings with air conditioning. The RTF's values for interactive factors vary depending on heating and cooling system types and building type. For some building types, especially those that tend to participate in the Site Specific program, the RTF's interactive factors are higher than Avista's factor

7.3.1.3 EnergySmart Grocer Program

Conclusion: Avista's EnergySmart Grocer program is successfully providing retail and restaurant customers with an avenue to upgrade their refrigeration equipment. Participation in the program includes both prescriptive and custom projects. The evaluation team's review of projects in the program resulted in a realization rate of 90%. For prescriptive projects, the evaluation team determined that RTF deemed savings values were being appropriately applied in most cases. However, low project-level realization rates for custom projects, which tend to be larger in size than prescriptive projects, are driving the program realization rate downward.

Recommendation: Avista should consider more internal review of energy savings estimates submitted by vendors for custom projects under this program. Alternatively, Avista could consider tracking custom projects under the Site Specific program with other projects of similar size and complexity.

7.3.1.4 Prescriptive Non-Lighting Other Programs

Conclusion: Avista reported 2014-2015 participation in six other prescriptive programs. Of these, the HVAC Motor Controls program is the largest, constituting 66% of the energy savings for this group. The evaluation team's review of projects in these programs resulted in a 54% realization rate. Cases of ineligible VFD projects receiving incentives were cause of the low realization rate for these programs.

Recommendation: Avista should revise the HVAC Motor Controls program to include more verification of motor eligibility status. More emphasis should be placed on confirming motor application and duty status to ensure compliance with the program's existing eligibility requirements. More specifically, Avista should place specific emphasis on ensuring VFDs are installed in a manner that saves energy (i.e. not just as "soft starters") and that incentivized VFDs serve primary-duty motors.

7.3.1.5 Small Business Program

Recommendation: It is recommended that the modified deemed savings values utilized by the evaluation team be adopted by the program for future reporting purposes.

7.3.2 Residential Programs

The overall realization rate for the residential portfolio is 99%. The realization rates varied significantly across the various programs evaluated with the Shell and Fuel Efficiency programs having the lowest realization rate (38% and 62% respectively). The evaluation team found that

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the reported savings for the majority of the programs were understating the actual impacts found from the evaluation activities. The following subsections outline specific conclusions and recommendations for several of the residential programs.

7.3.2.1 Appliance Recycling

Conclusion: The evaluation team found that the reported deemed savings value (per recycled unit) for the program was lower than estimated gross savings valued from prior studies. Avista may have aligned their deemed savings values close to the RTF deemed savings values, but it is important to understand that the RTF is reporting a value that accounts for net market effects (i.e. free ridership).

> **Recommendation**: If Avista choses to offer an appliance recycling program in the future, it is recommended that a clear distinction between gross and net savings values is noted if Avista reports the most current RTF values.

Conclusion: The evaluation team found discrepancies when comparing Avista's reported participation counts against the implementer reported values. The evaluation team believes that one reason for the discrepancies could be due to overlapping reporting periods and the way participants are reported and tracked.

> **Recommendation**: Avista should consider tracking the customer account number in addition to the name/address. It would be easier to track account numbers back to billing database records than the name /address fields, which are easier misspelled, and often formatted differently.

7.3.2.2 HVAC Program

Conclusion: The evaluation team found, through billing regression analysis, a relatively low realization rate for the Air Source Heat Pump measures (RR of 48.5%).

> **Recommendation:** The evaluation team recommends Avista reexamine the assumptions relating to annual per-home consumption and savings estimates in homes receiving ASHP installations. In addition, to help better understand the baseline for the ASHP replacement, Avista could consider requesting that contractors and customers provide a better description of the replaced unit

Conclusion: For the analysis of the Smart Thermostat measure, only five homes had sufficient post-retrofit billing data to estimate savings. Therefore, the evaluation team applied a 100% realization rate to the reported savings due to the small population.

> **Recommendation:** Given the inconclusive analysis results for this measure driven by data limitations, the evaluation team recommends Avista revisit the analysis of this measure in late 2016 - early 2017 when a full year of post-installation billing data is available for several hundred rebate recipients.

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7.3.2.3 Water Heat

Conclusion: For showerheads distributed through the Simple Steps program, Avista allocates 50% of its reported savings to electric savings and 50% to natural gas savings to account for homes that have different water heating fuel types.

> **Recommendation:** The evaluation team recommends Avista update this allocation assumption to be based on representative water heater fuel type saturation. These data are available through the Regional Building Stock Assessment study; however, we recommend Avista base the allocation on data specific to its territory.

7.3.2.4 ENERGY STAR® Homes

Conclusion: The evaluation team initially attempted to use a difference-in-means approach to estimate savings for the ENERGY STAR® Homes program. However, due to the small number of ENERGY STAR® Homes participants and absent any detailed characteristics of the homes (e.g. square footage, single- vs. multi-family, etc.) a reliable non-program comparison group could not be attained. Therefore, the evaluation team collected Home Energy Rating System (HERS) Index scores for participating ENERGY STAR® Homes wherever available to conduct the impact analysis.

> **Recommendation:** As more participants enter the program, the evaluation team recommends again attempting a difference-in-means approach to estimating the savings for the program, if sufficient data is available.

> **Recommendation:** To aid future evaluation efforts, the evaluation team recommends including the HERS scores in the program tracking documents. In addition, for stick-built ENERGY STAR homes, application forms could ask for the RESNET Registry ID, which is now assigned as part of RESNET Archival of all HERS Rated or ENERGY STAR homes. This will ensure that the home has been certified third party and is recognized by RESNET, the certifying agency for ENERGY STAR.

7.3.2.5 Fuel Efficiency

Conclusion: The evaluation team conducted a billing regression analysis for the Fuel Efficiency participants and found realization rates of 57-62% for rebate projects that included the conversion of a home's heating system from electricity to natural gas. When regression coefficients were examined in detail, the evaluation team noted that the estimated reduction in electric heating load was being offset by an increase in estimated base load within participating homes.

> **Recommendation**: Because the rebate amounts and per-home savings from Fuel Efficiency are so large and the number of participants is relatively low, the evaluation team recommends Avista ask participating customers for details on any additional home renovations that were completed in parallel with the fuel conversion. Home improvement projects such as an addition, finishing a basement, or adding air conditioning can

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drastically change the consumption patterns within a home and render the assumed baseline inaccurate.

Conclusion: The evaluation team found that over half the homes receiving Fuel Efficiency rebates in 2014-2015 did not have a gas billing history with Avista prior to the conversion. These homes realized savings at a higher rate than homes that did have previous gas service.

> **Recommendation**: The evaluation team recommends that Avista consider adding a field to the program tracking database that indicates the gas meter installation date or service start date of participating homes. This would more clearly delineate homes that were previously all electric and became dual-fuel around the same time as the Fuel Efficiency project, from homes that had been dual-fuel historically. Avista may also want to consider assuming a more conservative electric savings estimate for homes that had prior gas service because it's possible that the home was not 100% electrically heated prior to program participation.

7.3.2.6 Residential Lighting

Conclusion: Avista's deemed savings estimates, which were generally the same for all similar product types and not correlated to the bulb wattage, understated the savings found by the evaluation team. This was especially the case for Avista's CFL giveaway program.

> **Recommendation:** The evaluation team recommends that Avista consider more detailed product type deemed values in an effort to be more closely aligned with the actual participating lamps. Simple Steps has shifted its program tracking to specific product types by lumen bins in accordance with the most current BPA UES measure list. Avista should consider using these higher resolution deemed value for internal reporting with the Simple Steps program and for use with internal residential lighting programs.

An overarching recommendation is also for Avista to monitor the LED lamp market for technology cost changes and customer preferences, and consider increasing LED lamp options from the 2014-2015 portfolio in future DSM planning. Currently, LED prices are dramatically decreasing and customer preferences are shifting from CFL to LEDs as a preferred choice as an energy efficient technology. Consequently, CFLs shelf space share is declining as an abandoned technology, despite its better cost effectiveness compared to LED lamps.

7.3.2.7 Shell Program

Conclusion: The evaluation team found a low realization rate (38%) for shell rebate measures (windows and insulation). This finding indicates that reported savings values were too aggressive on average. The evaluation team compared the end-use shares estimated via regression analysis and found that only approximately 5,500 of the 13,000 kWh of average annual consumption in residential homes in Avista's service territory was assigned to heating and cooling load. Given this end-use share, the reported savings values claimed by Avista equate to a 25% reduction in HVAC loads.

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Recommendation: The evaluation team recommends Avista examine planning assumptions about per-home consumption, end-use load shares, and percent reductions in heating and cooling loads from shell improvements. It may be that the percent reduction assumptions are sound, but they are being applied to an overstated assumption of the average electric HVAC consumption per home. Conversely, the assumed end-use shares may be accurate, but the end-use reduction percentage is inflated. This investigation should be conducted separately for electrically heated homes and dual fuel homes as the heating electric end-use share will be different.

7.3.2.8 Opower Program

Conclusion: The evaluation team found that savings held fairly consistent during the 6 month interruption in Home Energy Report delivery. The finding reinforces Avista's decision to assume a multi-year measure life when calculating the cost-effectiveness of the Opower program.

Recommendation: The evaluation team recommends Avista examine the program delivery model in the 2016-2017 cycle. Given the fixed and volumetric nature of program costs, measure life assumptions, and mechanisms by which measured savings are counted toward goal achievement the evaluation team believes there are alternatives to the traditional delivery model that optimize program achievements relative to costs. As an example, Avista should consider not running the program during the second year of a biennium given the constraints currently in place. Per the hypothetical example below, the acquisition cost greatly increases in 2017 when a 2 year measure life with no decay is assumed.

Table 7-4: Opower Acquisition Cost Example

Year	kWh per Home	Annual Program Cost per Home	Tx Homes	MWh	Cost	Incremental MWh	Acquisition Cost ($/kWh)
2016	250	$15	50,000	12,500	$750,000	12,500	$0.06
2017	300	$15	46,000	13,800	$690,000	1,300	$0.53

7.3.2.9 Low Income Program

Conclusion: The evaluation team found a high realization rate for the fuel conversion measures implemented through the Low Income program. One reason for the high RR could be due to the fact that Avista caps the reported savings value to 20% of the contractor estimated savings. In addition, the evaluation team found that the verified savings for these fuel conversion measures aligned closely with the verified savings found through the regular-income Fuel Conversion program.

Recommendation: The evaluation team recommends re-evaluating the current savings cap for fuel conversion projects. In addition, we recommend that Avista align assumptions for fuel switching savings for the Low Income and Fuel Efficiency programs.

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8 Residential Lighting Study

In order to meet the objectives of the evaluation, the evaluation team collected data in the form of onsite metering of lighting fixtures in the homes of Avista customers. The study methodology chosen aligns with the Department of Energy (DOE) Uniform Measure Project (UMP) for residential lighting. The research team measured how many hours per day various lighting fixtures were illuminated during a six (6) month study period beginning July 2015 and lasting through January 2016, at the residences of 74 Avista customers.

An average of seven (7) lamps per home were metered across a random sample of fixture and room types, with 522 lighting meters deployed across Avista's service territory. Collecting data for an average of seven lamps per residence allowed for a large dataset to be gathered for analysis across multiple delivery streams, residence, and room types. Metered lamps included both efficient lamps (CFLs and LEDs) and inefficient lamps (e.g. incandescents and halogens). A full inventory of lighting (fixture, socket, lamp type, etc.) was also performed while onsite.

All recovered logger data was compiled into a dataset, analyzed, and summarized for hours of use and peak coincidence estimation. Total hours per day was calculated from the measurement results, which included ten-minute time intervals and the associated percent on for that metered fixture. The hours of use was estimated for each logger across every day of the metering period. This data was then weighted (by room type) to the inventory population and regressed against a sinusoidal curve to develop an annualized estimate. This sinusoidal based regression corrects for (annualizes) the metering period which spanned from July 2015 through January 2016.

8.1 Methodology

8.1.1 Household Sampling Approach

To develop the sample frame, the evaluation team drew a stratified random sample of potential participants from Avista Utilities' customer list. This list was used to recruit participants. The sample was stratified by a proportional share of customer energy load in each state. Customers consuming less than 2,000 kWh/ year were removed from the list of potential study candidates[28]. The sample frame was further stratified based on geographic region (ID-North, ID-South, WA-North, WA-Central, and WA-South) and premise type (single family vs. multifamily). The sample structure was designed to be representative of program participation and the population at large, as practical. The representativeness controls the research team established when recruiting participants in the study include:

Participation by geographic region (ID-North, ID-South, WA-North, WA-Central, and WA-South)

[28] It is assumed that a typical customer home consumes at least 2,000 kWh per year. This control, therefore, will remove non-home premises from the sample.

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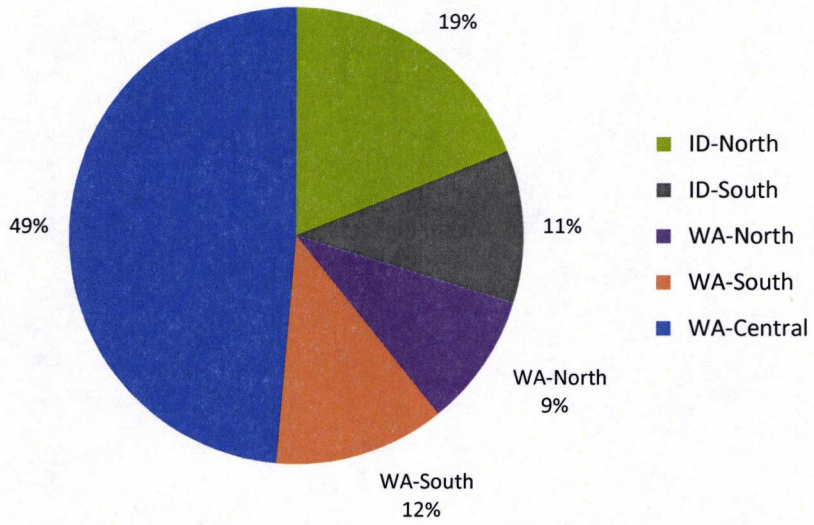
- Participation by dwelling type (single family vs. multifamily)
- Participation by household income level (low income vs. non-low income)
- Participation by geographic type (rural vs. urban)
- Participation by age of head of household

As outlined in the figures below, the evaluation team believes that the controls have been met to ensure that the sample is representative of the population.

The evaluation team targeted 33% Idaho region (21% ID-North and 12% ID-South) and 67% Washington region (9% WA-North, 11% WA-South, and 47% WA-Central) participation in the study. This split was based on the share of energy consumption by region. Figure 8-1 shows that the actual split of participants was a representative 30% Idaho (19% ID-North and 11% ID-South) and 70% Washington (9% WA-North, 12% WA-South, and 49% WA-Central).

Figure 8-1: Actual Customer Participation by Region



Another important check to ensure a representative sample was to control for housing type (single family vs. multi-family). We researched the current split of residents in the State of Washington for these two housing types at 26% multi-family and 74% single family[29]; with the State of Idaho researched to be 15% multi-family and 85% single family[30]. Figure 8-2 shows that the research team achieved a representative sample with 81% single family and 19% multi-family participants in Washington and 86% single family and 14% multi-family participants in Idaho.

[29] Based on 2015 U.S. Census data for the State of Washington - http://quickfacts.census.gov/qfd/states/53000.html

[30] Based on 2015 U.S. Census data for the State of Idaho - http://quickfacts.census.gov/qfd/states/16000.html

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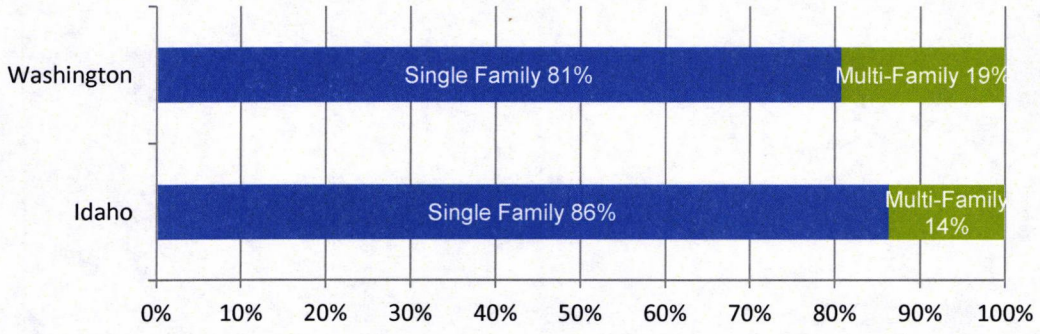
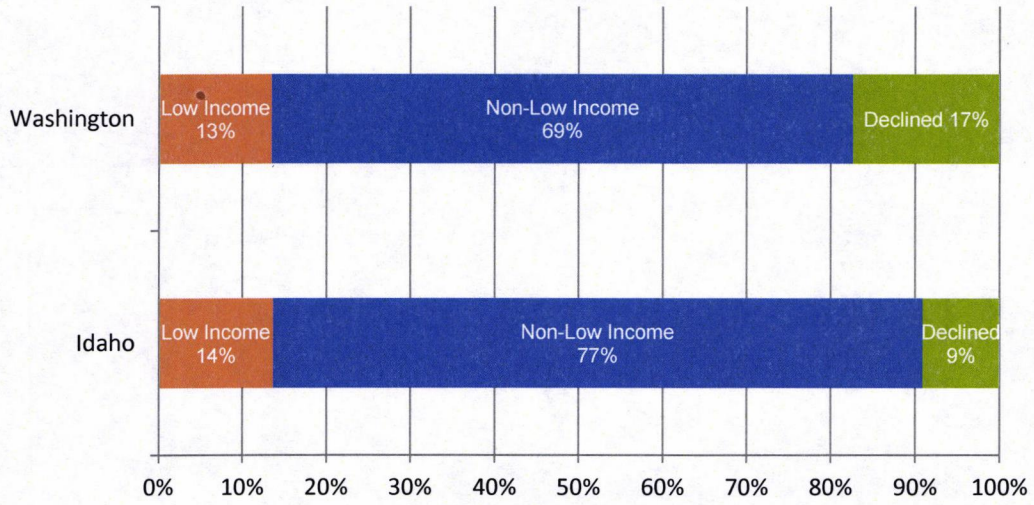
Figure 8-2: Actual Participation by Dwelling Type



A third important factor we took into consideration, and monitored to ensure a proper representative sample, was the household income level (low income vs. non-low income).The State of Washington listed 13% within the low income range and 87% non-low income[31]. Similarly, the state of Idaho listed 16% within the low income range and 84% non-low income[32]. Figure 8-3 shows that the research team achieved a representative sample with 13% low income and 69% non-low income participants in Washington (17% of participants declined to answer the survey question) and 14% low income and 77% non-low income participants in Idaho, with 9% declining.

Figure 8-3: Actual Participation by Household Income



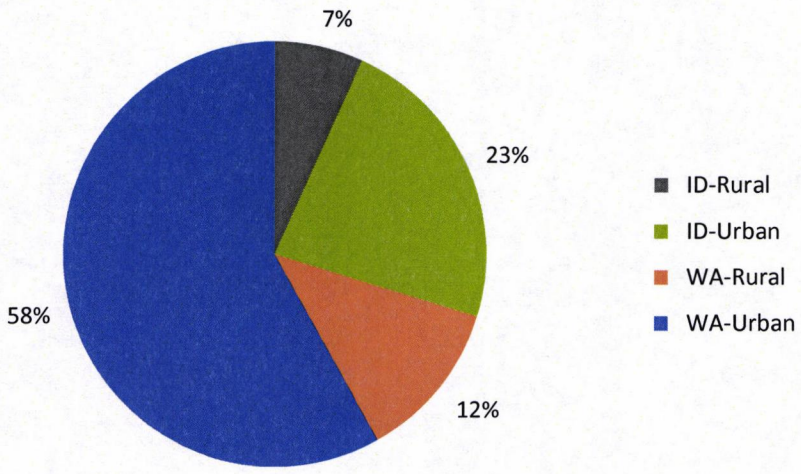
Additionally, the evaluation team reviewed and incorporated the delineation of geographical areas (urban vs. rural) into the sampled homes to further ensure a proper general population representation. The customer counts within Avista's territory showed 53.6% of the population is

[31] Based on 2015 U.S. Census data for the State of Washington - http://quickfacts.census.gov/qfd/states/53000.html

[32] Based on 2015 U.S. Census data for the State of Idaho - http://quickfacts.census.gov/qfd/states/16000.html

considered WA-Urban, while 12.6% is WA-Rural, 23.2% is ID-Urban, and 10.6% is ID-Rural. Figure 8-4 shows that the research team achieved a representative sample with 58.1% WA-Urban, 12.2% WA-Rural, 23.0% ID-Urban, and 6.8% ID-Rural.

Figure 8-4: Actual Participation by Geographical Area



Finally, evaluation team also conducted representativeness checks to ensure participants were from a cross-section of age demographics. The age of the head of household (HOH) was collected for each home visited. The distribution of study participants is provided in Table 8-1 and is reasonably representative of the age demographics for the States of Washington and Idaho. 8.1% of the homes visited declined to provide the age of their head of household, but confirmed it was over the age of 18.

Table 8-1: Head of Household Age Participant Share

HOH Age	Target Participation by Age33	Actual Participation by Age
18 to 24	12.0%	1.4%
25 to 44	36.0%	23.0%
45 to 64	36.0%	41.9%
>65	16.0%	25.7%
Declined	0.0%	8.1%

8.1.2 Logger Deployment Sampling Approach

Because the upstream and giveaway components of the Avista lighting program do not target specific fixtures or high-usage areas in the home, the study metered an average of seven (7) lamps per home across a random sample of fixture and room types in the homes of 74 Avista

[33] Based on combined 2012 U.S. Census data for the State of Washington and the State of Idaho

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customers. Metered lamps included CFLs, LEDs, halogens, incandescent lamps and other misc. lamps. The lighting study targeted annual operating hour results with 9% precision at the 90% confidence level for the 522 loggers successfully deployed in metered homes.

In addition to the controls mentioned above, the research team also sought to achieve statistically meaningful results for multiple room types, as well as CFL/LED versus incandescent operating hours. The study intended to place a higher proportion of loggers in high-use room types (such as family/living room) to provide higher levels of statistical confidence for those room types. The targeted sample frame of logger deployment by room type is illustrated in below.

Table 8-2: Sample Frame of Logger Deployment by Room Type, by Bulb Type

Room Type	# of Loggers		
	CFL/LED	Incandescent	Total
Bathroom	20	19	39
Bedroom	45	45	90
Dining Room	35	34	69
Foyer/Hallway	20	20	40
Kitchen	35	34	69
Family/Living Room	45	45	90
Garage/Attic/Other	35	34	69
Other	35	34	69
TOTAL	**270**	**265**	**535**

8.1.3 Primary Data Collection

To accurately meet the objectives of this study the evaluation team designed an approach which utilized a primary data collection approach in the form of onsite surveys & metering of customer homes. Onsite surveys and metering provides highly accurate data because information is collected and loggers deployed by trained engineers with experience identifying and properly deploying metering equipment on lighting fixtures. The methods used to collect data through onsite visits are detailed below.

8.1.3.1 Recruitment & Participant Criteria

1,500 general population Avista customers were contacted via a mailed letter (Appendix E) to ask for their participation in the study. Recruitment letters (Appendix E) were mailed to the sample frame customers. The letter introduced them to the study, and requested they call a toll-free phone number to speak with an evaluation team representative if they were interested in participating in the study, or had further questions. Participants were provided a $75 incentive to participate in the study ($25 at the time of logger installation and $50 when the loggers were collected) to participate in the study.

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8.1.3.2 Lighting Inventory

An inventory of all the lighting fixtures and lamps was performed while at each participant's home. The purpose was not only to provide insightful saturation data on CFL, LEDs and other lamps, but provided the necessary information to properly weight the hours of use data by room type. Upon arrival at the home, the field engineer inspected each room and took a full inventory of all the lighting circuits, fixtures and lamps. Data collected include:

- Circuit Type
- Room Type & Description
- Fixture type and quantity
- Socket type and socket quantity per fixture
- Lamp type, lamp shape, and lamp quantity per fixture
- Watts per lamp (when available)

The categorization utilized to identify fixture, socket and lamp types can be found in the Lighting Inventory Form in Appendix C.

8.1.3.3 Measurement Activities

An average of seven (7) HOBO® on/off and light intensity data loggers were placed in each of the 74 customer homes that participated. The data loggers utilized for this study include:

- HOBO UX90-002 Light On/Off
- HOBO U9-002 - Light On/Off
- HOBO U12-012 Temp/RH/Light Intensity

The light on/off loggers simply measure on-off luminosity events that exceed a pre-set threshold, while the intensity logger measures incremental changes in luminosity. While all loggers can be calibrated to accurately record data in any setting, the on/off loggers were targeted for deployment in low ambient lighting settings, while the intensity loggers were targeted for deployment in high ambient lighting settings. HOBO UX-90 light pipes were also deployed to help ensure the logger sensors were more effectively recording lamp luminosity, and not ambient light changes.

The location of loggers placed on the various fixtures and rooms in each home was determined by a random sampling methodology that was programmed into a smart phone randomizer application ("app") developed by the evaluation team that deterred the field engineer from introducing any bias into the where the loggers were deployed. The randomizer app required the field engineer to enter in the number of lighting circuits[34] in a home and identify which ones

[34] For the purposes of this study, a circuit is defined as the series of one or more lights controlled by a single switch (e.g. wall switch). By using circuits as the selection criteria, as opposed to fixtures, the research team was able to collect unique data sets (as logging data for more than one fixture on a single circuit would provide duplicate results).

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had a CFL or LED installed on it; at which point a random sample of lighting circuits would be provided to the engineer. The field engineer then installed the lighting loggers on one fixture for the identified circuits. In order to obtain as much data as possible on CFLs and LEDs, the randomizer app was programmed to automatically include up to four (4) circuits that had CFL/LED lamp fixtures. The remaining circuits were then randomly selected for the remaining loggers. Additionally, the sampling algorithm confirmed compliance with the overall target sample frame to ensure representativeness of the general population with respect to room type. When room type quotas were reached, the evaluation team engineers refrained from installing any additional loggers in that room type.

In order to fully estimate the changes in daily operating schedules, the research team sought to have loggers deployed at least one month in each season (summer, fall and winter). Based on the delivery schedule of this study, the evaluation team began its six-month metering duration in July/August 2015 and retrieved all the loggers in January 2016.

8.1.4 Data Analysis

8.1.4.1 Data Cleaning

After removal of the loggers in January 2016, analysts downloaded logger data using HOBOware software and imported the data into STATA for generating summary statistics, data cleaning, hours of use and peak coincidence factor estimation. The research team also reviewed logger notes documented by the removal team to determine whether to include or exclude each logger from the HOU analysis. Based on these removal notes, analysts determined loggers to be excluded from the HOU analysis based on the following circumstances:

- Participants prematurely removed loggers from metered fixtures
- Participants didn't respond to repeated requests by research team to pick up loggers
- Loggers were damaged at the customer home
- Logger malfunction (e.g. battery) led to incomplete dataset
- Field Engineer didn't correctly "launch" logger during installation
- High ambient light conditions resulted in poor data quality

Initial review of the logger data for viability and outlier behavior was a two-step process based on the logger type: for intensity loggers the data was exported into histograms for review while event loggers (on/off events) were reviewed by STATA code. Analysts reviewed all raw intensity logger data using histograms exported into Excel, specifically targeting minimum thresholds for what would qualify as a light-on event specific to each logger. Loggers with very low or very high intensity readings or reading that appeared suspect were reviewed further; ultimately nine loggers were removed from the analysis due to questionable intensity readings.

Loggers flagged as questionable by the removal team (e.g., the participant removed the logger, the logger fell off the fixture, poor installation, etc.) were carefully reviewed to ensure that data

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represented *in situ* observations. As poor logger installation did not always result in bad data, some data from improperly installed loggers were included in the analysis. Some loggers were immediately coded as "remove" if they recorded data for only a small fraction of metering period (less than one month of data points), the loggers were damaged, and other anomalies.

To provide a general quality control check, analysts wrote the STATA program to "trim" data points occurring before or on the day of the install date or on the day or after the removal date. This check prevented analysis from including events occurring prior to installation, in case a technician did not reset the logger at the time of installation. The check also prevented the analysis from including events occurring after the removal date, if logger data were downloaded on a day other than the removal date.

Once the light logger data was completely cleaned, the data was merged with the household lighting audit data collected during logger installations. Table 8-3 shows the distribution of total loggers retained for final analysis (loggers with viable data) by room type. After data cleaning, a total of 459 loggers were available for the hours of use and coincident factor analysis.

Table 8-3: Distribution of Loggers Installed by Room with Viable Data

Room	Loggers with Viable Data[35]
Kitchen	61
Dining	33
Living/Great/Family	79
Foyer/Hall/Stair	42
Bedroom	77
Toilet/Bathroom	48
Other	119
TOTAL	**459**

8.1.4.2 Development of Weights

The total number of lamps metered with a data logger was weighted back to the inventory population based on two primary criteria: 1) the data was weighted to match the entire inventory sample population's distribution of total lamps by room type, and 2) the entire inventory sample populations' distribution of total lamps by source of efficient light bulbs (delivery stream). Population weights were developed by calculating the inverse of a lamp's probability of being metered with a data logger. This resulted in a different weight for each combination of room type and source of efficient light bulb, and renders the logger-based lamp sample frame equivalent to a simple random sample. Table 8-4 shows the population weights calculated using the inventory-based, and logger-based, lamp counts.

[35] This represents the number of loggers included in the analysis after data cleaning.

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Table 8-4: Population Weights Applied to Sample Frame

Room	Lamp	Inventory-based Lamp Count (A)	Logger-based Lamp Count (B)	Population Weight (A / B)
Kitchen	CFL	93	54	1.7
	Incandescent	316	95	3.3
	LED	94	31	3.0
Dining	CFL	23	18	1.3
	Incandescent	190	89	2.1
	LED	25	22	1.1
Living/Great/Family	CFL	155	53	2.9
	Incandescent	326	70	4.7
	LED	49	11	4.5
Foyer/Hall/Stair	CFL	55	21	2.6
	Incandescent	223	33	6.8
	LED	13	8	1.6
Bedroom	CFL	182	50	3.6
	Incandescent	432	77	5.6
	LED	42	4	10.5
Toilet/Bathroom	CFL	144	55	2.6
	Incandescent	461	73	6.3
	LED	24	3	8.0
Other	CFL	276	83	3.3
	Incandescent	753	108	7.0
	LED	26	4	6.5

8.1.4.3 Hours of Use Modeling

Estimates of HOU were developed by first annualizing the logger data, and then applying a hierarchical linear model. The logger data was annualized to simulate a full year of data for loggers that were installed for part of the year. The hierarchical linear model was applied, with the population weights, to estimate HOU with standard errors that reflect the structure of the sample.

8.1.4.4 Development of Annualized HOU

Residential lighting usage, both frequency and duration-based, is partly a function of ambient daylight. Lamps used in rooms without access to daylight (closets, basements, and other windowless rooms), along with lamps with usage independent of daylight (lights on timers or lights turned on when home from work), can be classified as "base load" lights. Overall, HOU for homes is based on this base load usage, combined with usage dependent on hours of daylight.

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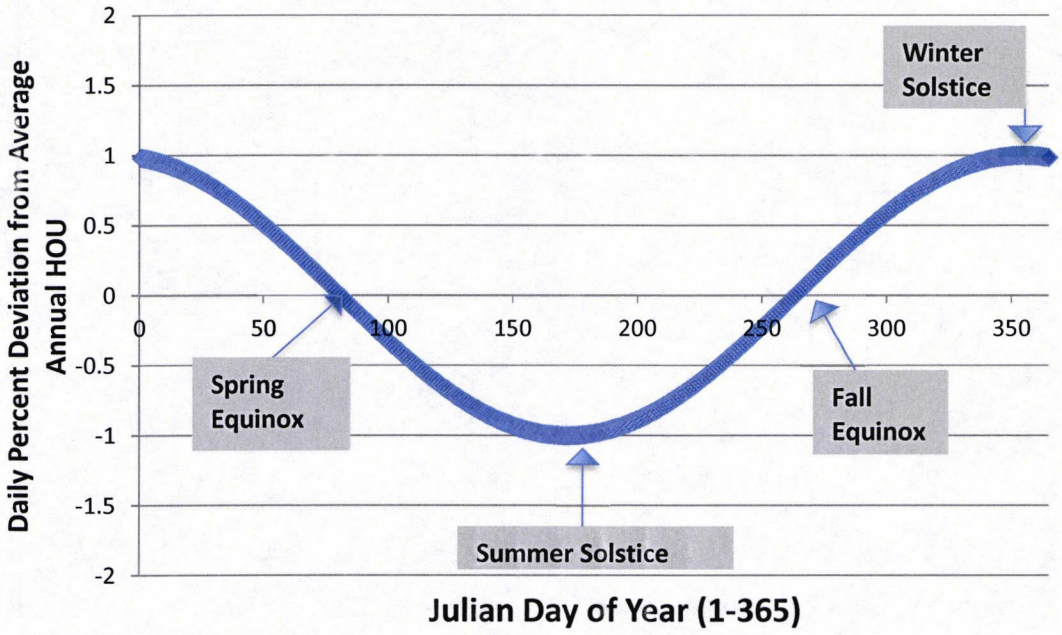
Overall usage, therefore, fluctuates over the course of a year given fluctuations in daylight hours.

The average HOU for all lamps during the summer solstice (beginning June 21) is expected to be the lowest of the year, while HOU usage during winter solstice (beginning December 21) to be the highest of the year. Average annual use is assumed to be coincident with the spring and fall equinox, occurring on March 20 and September 22, respectively. For example, the fraction of the daily percent difference from the average annual daylight hours across one year is represented as a sinusoid curve. This curve can be represented by the equation $sin(-2\pi(284+d)/365)$, where d is the Julian date of the year (January 1 = 1, December 31 = 365). Figure 8-5, the peak and trough (at 1 and -1, respectively) represent the winter and summer solstices, and 0 represents the spring and fall equinoxes (effectively the annual average daylight hours).

Figure 8-5: Percent Deviation from Average Annual Daylight Hours



Light logger data were collected during a six-month period starting July 2015 and removed from the homes in January 2016. Basing HOU on these data alone would result in a low estimate, as lighting HOU and daylight hours are inversely related. In other words, HOU should increase with decreasing daylight. Annualization of the spring and summer-only HOU estimate was required to adjust this HOU to an annual value.

The basis for the HOU annualization is the UMP Chapter 6: Residential Lighting Evaluation Protocol[36]. According to the UMP: "Due to the seasonality of lighting usage, logging should be

[36] *The Uniform Methods Project Methods for Determining Energy Efficiency Savings for Specific Measures*, Scott Dimetrosky, Apex Analytics LLC. April, 2013. https://www1.eere.energy.gov/wip/pdfs/53827-6.pdf

conducted in total for at least six months and capture summer, winter, and at least one shoulder season — fall or spring. At a minimum, loggers should be left in each home for at least three months (that is, two waves of three months each to attain six months of data). All data should be annualized using techniques such as sinusoidal modeling to reflect a full year of usage." The UMP goes on to discuss the sinusoid regression: "Sinusoidal modeling assumes that hours of use will vary inversely with hours of daylight over the course of a year. Sinusoid modeling shows that (1) hours of use change by season, reflective of changes in the number of daylight hours and weather and (2) these patterns will be consistent year to year, in the pattern of a sine wave. An example of this approach is provided in the evaluation of the 2006 - 2008 California Upstream Lighting Program evaluation."

A sinusoid curve, best representing annual changes in daylight hours, was then statistically fit to weekend and weekday logger data using the following equation:

Equation 8-1: Sinusoidal Model Specification

$$HOU_d = \beta_0 + \beta_1 \sin\theta_d + \varepsilon_d$$

Where:

HOU	= hours of use;
θ	= angle, in radians, representing the amount of sunlight on the day. Theta is – for the spring and autumnal equinoxes, pi / 2 for the winter solstice, and –pi / 2 for the summer solstice;
d	= the day of the year;
β_0	= the intercept, representing the annual average HOU estimate (which coincides with the spring and fall equinox);
β_1	= coefficient representing the difference between the HOU on the solstice and the average HOU (maximum amplitude of the curve); and
ε	= error term.

For the Avista HOU lighting analysis, the evaluation team leveraged this sinusoid model to calculate the adjusted average annual HOU, based on the available logger data. We used separate models for weekday and weekend data, and regressed mean daily use for the relevant days in the metering period on the sin(θd) associated with those days. Drawing on methodology used in the Pennsylvania 2014 Commercial & Residential Light Metering Study[37], a sinusoidal model was deemed to have a poor fit if one of the following criteria was met:

1) β_1 has an absolute value greater than 10;
2) The standard error for $\beta_1$is greater than 1;
3) β_0 is less than or equal to 0; and
4) β_0 is greater than 24.

[37] Pennsylvania Statewide Act 129 2014 Commercial & Residential Light Metering Study. Prepared by the Pa Statewide Evaluation Team; GDS Associates, Nexant, Research Into Action, Apex Analytics. January 13, 2014.

Based on the above criteria, 37 of 916 sinusoidal models were identified as poorly fit. Those 37 represented 30 loggers (because weekend and weekday data was modeled separately, a single logger had two sinusoidal models associated with it). Rather than using the fitted values for those 37 models, the average HOU from the logger data was used to estimate annual HOU.

8.1.4.5 Hierarchical Model

A weighted hierarchical (or multilevel) model was developed to estimate average HOU for the home.[38] The key advantage of the hierarchical approach is that the model takes into account in-home lighting usage covariance in estimating coefficients. This is important as lighting across multiple loggers in the same home are likely to have some covariance associated with the usage behavioral patterns of the home's occupants. For instance, during an extended vacation, nearly all of the lights in the home may be off, and all of those loggers would record zero usage during those same dates.

The model includes random effects for the intercept at the household level, which accounts for correlation among loggers within a home. To estimate HOU for various categories such as room type, lamp usage category and fixture type, fixed effects variables were included in the model. The specification shown in equation 2 below features fixed effects for room type, but the model takes a similar form for other categories.

Equation 8-2: Hierarchical Linear Model for HOU

$$HOU_{h,i} = (\beta_0 + b_{0,h}) + \sum_r \beta_r I_r + \epsilon_{h,i}$$

Where:

HOU	= hours of use
$b_{0,h} \sim N(b_h, \sigma^2_{b_h})$	
h	= index for home
i	= index for logger
r	= index for room type
I_r	= indicator variable for room type
β_x	= fixed effects coefficients
$b_{0,}$	= random effects coefficients
ε	= error term

8.1.4.6 Coincidence Factor Modeling

Avista has three peaks for which coincidence factors were calculated: a summer peak from 5 to 6.30 PM, a winter peak from 7 to 8 AM, and a winter peak from 5 to 6 PM. For each peak, the coincidence factor is average percent of the hour lights are on during the defined peak period of non-holiday weekdays.

[38] Hierarchical models are described very briefly here. For further details, refer to the following: Woltman, Feldstain, MacKay, and Rocchi, *An introduction to hierarchical linear modeling;* Goldstein, Harvey, *Multilevel Statistical Models;* and Sullivan, Dukes, and Losina, *Tutorial in Biostatistics: An Introduction to Hierarchical Linear Modeling.*

Since loggers were in place for nearly an entire summer period (July through September), and nearly an entire winter period (November through January and, in many cases, some part of February), sinusoidal model estimates were not used in the estimated CF. Average CF was computed for each peak period for each logger and then a hierarchical model was developed to estimate CF. The model has a similar form to that used to estimate HOU, featuring random effects for the intercept at the household level, which accounts for correlation among loggers within a home. To estimate CF for various categories such as room type, lamp usage category and fixture type, fixed effects variables were included in the model. The specification shown in equation 3 below features fixed effects for room type, but the model takes a similar form for other categories. The CF during each of the three peak periods was estimated separately using the same specification.

Equation 8-3: Hierarchical Linear Model for HOU

$$CF_{h,i} = (\beta_0 + b_{0,h}) + \sum_r \beta_r I_r + \epsilon_{h,i}$$

Where:

CF	= coincidence factor during a particular peak period;
$b_{0,h} \sim N(b_h, \sigma^2_h)$;	
h	= index for home
i	= index for logger
r	= index for room type
I_r	= indicator variable for room type
β_x	= fixed effects coefficients
$b_{0,h}$	= random effects coefficients
ε	= error term

8.2 Lighting Inventory Findings

An important part of the residential HOU study is the collection of bulb saturation data across the homes that participated in the study. Saturation studies are useful tools to help gauge the market penetration of efficient lighting products to assess past program effectiveness and to determine future potential for continued lighting program efforts. Additionally, collecting supplemental information about each user and home of where the bulbs were installed allows segmenting the analysis to frame and design future programs to target these areas of highest potential.

There were a total of 3,902 lighting sockets reviewed based on the 74 homes surveyed (or an average of 53 sockets per home). The evaluation team found CFL socket saturation to be 23.8% and LED saturation at 7.0%. The combined less efficient (non CFL/LED) 69.2% bulb saturation can be viewed as the maximum available potential for future CFL and/or LED installations.

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Table 8-5: Lighting Inventory Summary Saturation by Lamp Type

Lamp Type	Total Bulbs	Lamp Distribution %
CFL	928	23.8%
Empty Socket	71	1.8%
Halogen/Quartz	152	3.9%
Incandescent	2102	53.9%
LED	273	7.0%
Linear Fluorescent	353	9.0%
Other	6	0.2%
N/A	17	0.4%
TOTAL	**3,902**	**100%**

8.2.1 CFL & LED Saturation by Room Type

Knowing which rooms have the most CFL and LED lamps installed helps to understand how consumers are using and installing energy efficient bulbs. Table 8-6 shows the CFL and LED saturation by room type, with living/great/family room type having the highest CFL saturation (29.2% CFL saturation), whereas dining rooms have the lowest CFL saturation (9.7%). Kitchens had the highest LED saturation (18.7%) and "Other" rooms had the lowest LED saturation (2.5%). Figure 8-6: Lighting Inventory Summary of Room and Lamp Type shows the complete lighting inventory represented by room and lamp type.

Table 8-6: Lighting Inventory Summary CFL Saturation by Room Type

Room Type	Total Bulbs	CFLs	CFL Saturation	LED	LED Saturation
Kitchen	503	93	18.5%	94	18.7%
Dining	238	23	9.7%	25	10.5%
Living/Great/Family	530	155	29.2%	49	9.2%
Foyer/Hall/Stair	291	55	18.9%	13	4.5%
Bedroom	656	182	27.7%	42	6.4%
Toilet/Bathroom	629	144	22.9%	24	3.8%
Other	1055	276	26.2%	26	2.5%
TOTAL	**3,902**	**928**	**23.8%**	**273**	**7.0%**

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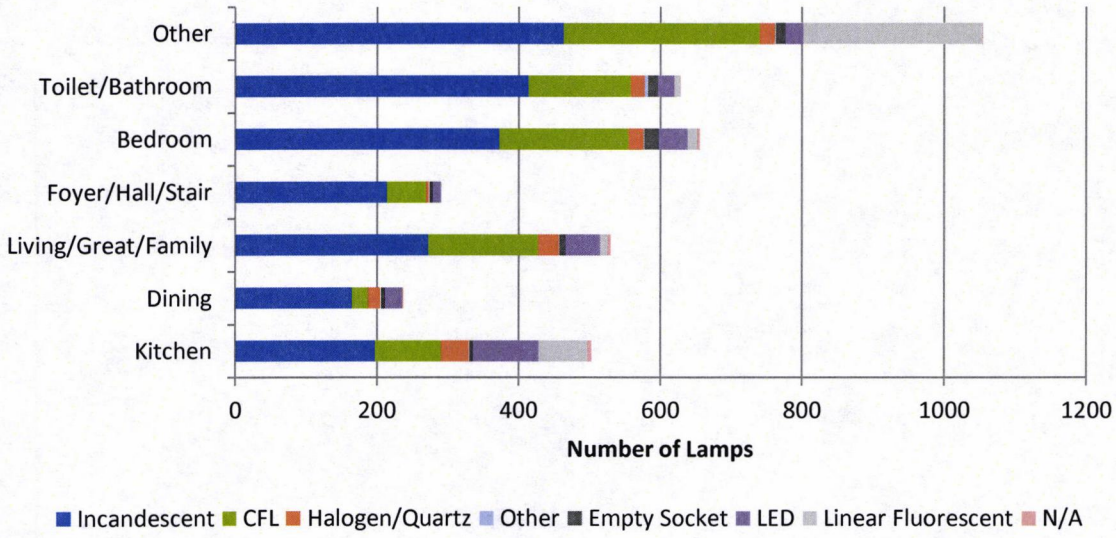
Figure 8-6: Lighting Inventory Summary of Room and Lamp Type



8.2.2 CFL & LED Saturation by Socket and Circuit Type

As shown in Table 8-7 the majority (76.8%) of the sockets are medium screw based bulbs, followed by pin based bulbs (10.4%). CFL saturation is highest for the medium screw based fixtures (30.2%) and LED saturation is highest for the "Other" socket type at 40.8%. Also shown below in Table 8-8 is the majority (86.7%) of circuits are represented by the standard on/off switch. If remote control and other circuits are excluded (since there were only 4 total circuits represented in this study) circuits with dimmer capabilities have the lowest CFL saturation (7.6%) and timers have the lowest LED saturation (2.6%).

Table 8-7: Lighting Inventory CFL Saturation by Socket Type

Socket Type	Total Sockets	Socket Type Distribution	CFL Saturation %	LED Saturation %
Medium Screw Base (standard)	2,998	76.8%	30.2%	5.8%
Small Screw Base (candelabra)	353	9.0%	2.0%	1.1%
Pin Base	404	10.4%	2.5%	8.4%
Other	147	3.8%	4.1%	40.8%
TOTAL	**3,902**	**100.0%**	**23.8%**	**7.0%**

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Table 8-8: Lighting Inventory CFL Saturation by Circuit Type

Circuit Type	Total Circuits	Total Sockets per Circuit Group	Circuit Type Distribution	CFL Saturation %	LED Saturation %
3-way	59	198	3.5%	8.1%	12.1%
Dimmer	76	302	4.5%	7.6%	4.3%
Motion/Photo Sensor	26	42	1.5%	19.0%	4.8%
On/Off (switch, plug, string)	1460	3238	86.7%	26.4%	7.2%
Other	1	2	0.1%	0.0%	0.0%
Remote Control	3	6	0.2%	0.0%	0.0%
Timer	23	38	1.4%	31.6%	2.6%
N/A	36	76	2.1%	19.7%	0.0%
TOTAL	**1,684**	**3,902**	**100.0%**	**23.8%**	**7.0%**

8.2.3 CFL & LED Saturation by Housing Type and Ownership Status

Multi-Family homes have the highest CFL saturation (close to 33%) while mobile homes had the highest LED saturation at 14.2% (though the level of confidence in this estimate is low since there were only 5 mobile homes in the sample). Interestingly, CFL saturation was the highest in rental households (38.3%) while LED saturation was highest in owner-occupied households (7.7%).

Table 8-9: Lighting Inventory CFL Saturation by Building Type

Building Type	Number of Homes in Sample	Number of Sockets	CFL Saturation %	LED Saturation %
Mobile Home	5	218	25.2%	14.2%
Multi-Family (3+ Units)	10	167	32.9%	0.6%
Single Family (1 unit)	57	3,450	23.3%	7.0%
Single Family Attached (2 units)	2	67	19.4%	0.0%
TOTAL	**74**	**3,902**	**23.8%**	**7.0%**

Table 8-10: Lighting Inventory CFL Saturation by Ownership Type

Ownership Status	Number of Homes in Sample	Number of Sockets	CFL Saturation %	LED Saturation %
Own	56	3,460	21.9%	7.66%
Rent	16	376	38.3%	1.06%
N/A	2	66	37.9%	6.06%
TOTAL	**74**	**3,902**	**23.8%**	**7.00%**

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8.2.4 CFL & LED Saturation by Region

Table 8-11 shows the CFL and LED saturation by region. The Avista region with the highest CFL and LED saturation was WA-Central with 30.3% and 10.7% respectively. The region with the lowest CFL saturation was WA-North (10.1%), while WA-South had the lowest LED saturation (1.2%).

Table 8-11: Lighting Inventory CFL Saturation by Region

Region	Homes in Sample	Number of Sockets	CFL Saturation %	LED Saturation %
Idaho	**22**	**1,231**	**18.8%**	**4.8%**
ID-North	14	648	18.4%	5.1%
ID-South	8	583	19.2%	4.5%
Washington	**52**	**2,671**	**26.1%**	**8.0%**
WA-North	7	317	10.1%	3.5%
WA-South	9	514	20.8%	1.2%
WA-Central	36	1840	30.3%	10.7%
TOTAL	**74**	**3,902**	**23.8%**	**7.0%**

8.2.4.1 Program Participation & Misc. Saturation Findings

While onsite, evaluation team engineers asked homeowners if they recall receiving free light bulbs from Avista from the Avista light bulb give-away program. Table 8-12 shows that percentage of participants that recall receiving the free light bulbs. We also found that of those customers that recall receiving a free light bulb, 100% of them installed the free light bulb.

Table 8-12: Free CFL Program Participation Findings

Building Type	Total Homes Visited	% of homes that recall receiving free lights
Mobile Home	5	80.0%
Multi-Family (3+ Units)	10	40.0%
Single Family (1 unit)	57	56.1%
Single Family Attached (2 units)	2	50.0%
TOTAL	**74**	**55.4%**

Engineers also recorded information on household space heating and space cooling equipment, as well as asked them about the number of portable electronics in the household. The research team found that 81% of households have a furnace to provide their space heating needs, while 54% of households use a central A/C systems for space cooling (Table 8-13 and Table 8-14). 5.4% of households were found to have no space cooling equipment present.

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Table 8-13: Space Heating Equipment Saturation

Space Heating Equipment Type	Households	Equipment Count	Saturation
Baseboard	8	8	10.8%
Furnace	60	60	81.1%
Other	4	4	5.4%
N/A	2	2	2.7%
TOTAL	**74**	**74**	**100.0%**

Table 8-14: Space Cooling Equipment Saturation

Space Cooling Equipment Type	Households	Equipment Count	Fuel Share %
Central A/C	40	40	54.1%
Fan	3	3	4.1%
Other	4	4	5.4%
Window A/C	23	23	31.1%
None	4	4	5.4%
TOTAL	**74**	**74**	**100.0%**

The share of households that use natural gas as their primary space heating fuel was estimated at 68.9%, while the share of households that utilize electricity as their primary space heating fuel was estimates at 24.3% (Table 8-15). The research team also asked the participants to estimate the number of portable electronics in their household – and found the average number of portable electronics per household to be 3.7.

Table 8-15: Space Heating Fuel Share

Space Heating Fuel Type	Households	Fuel Share %
Electric	18	24.3%
Gas	51	68.9%
Oil	2	2.7%
Pellets	1	1.4%
Wood	1	1.4%
N/A	1	1.4%
Total	74	100%

8.3 Lighting Hours of Use Findings

8.3.1 Aggregate Hours of Use

The overall daily lighting hours of use (HOU) annualized across the entire year is estimated to be 1.94. This value is estimated with a 90% confidence and 15.3% precision. Given a calculated

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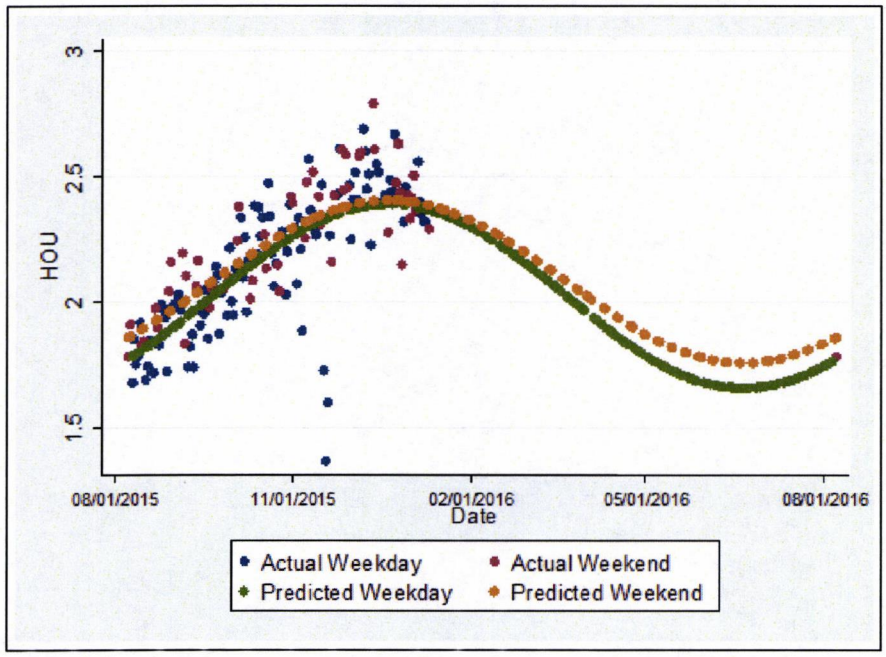
0.18 standard error, the research team estimates this annualized daily HOU value could be as low as 1.64 hours/day or as high as 2.23 hours/day.

Table 8-16: Aggregate Lighting Socket Hours of Use

HOU Estimation	Mean HOU	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
Hierarchical Estimate, Clustered SE	1.94	0.18	15.3%	1.64	2.23

The predicted and actual aggregated hours of use from August 8th, 2015 through January 10th, 2016 is displayed in Figure 8-7 below.

Figure 8-7: Aggregate Hours of Use Actual and Annualized Estimate



8.3.2 Hours of Use by Lamp Type

The evaluation team also investigated the differences between bulb types within the homes metered. Higher efficiency bulbs such as CFLs and LEDs showed considerably higher overall hours of use (2.21 and 3.37, respectively) relative to inefficient bulbs such as incandescents (1.69). The results are statistically significant as found in Table 8-17.

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Table 8-17: Hours of Use by Lamp Type

Lamp Type (Logger Level)	Mean HOU	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
CFL	2.21	0.22	16.8%	1.84	2.58
Incandescent	1.69	0.18	17.7%	1.40	1.99
LED	3.37	0.77	37.7%	2.10	4.64

8.3.3 Hours of Use by Room Type

Finally, the team investigated the differences in lighting hours of use across various room types. Kitchens were the highest HOU, with well above 3 hours/day, relative to bedrooms and foyer/hall/stairways, which are lower-use rooms (just over 1 hour/day). The research team also calculated the estimated hours of use by high/moderate and low usage room types. The results are and presented in Table 8-18 and Table 8-19 respectively.

Table 8-18: Hours of Use by Room Type

Room (Logger level, weighted by event type)	Annualized Room-Based HOU	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
Kitchen	3.75	0.45	19.57%	3.02	4.48
Dining	2.48	0.55	36.43%	1.57	3.38
Living/Great/Family	2.41	0.31	21.31%	1.90	2.93
Foyer/Hall/Stair	1.25	0.37	49.09%	0.63	1.86
Bedroom	1.25	0.18	23.08%	0.97	1.54
Toilet/Bathroom	1.82	0.30	27.46%	1.32	2.32
Other	1.52	0.25	26.53%	1.12	1.92

Table 8-19: Hours of Use by Room Usage Type

Room Usage Type (Logger level)	N	HOU	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
High Use	314	3.03	0.31	16.58%	2.53	3.53
Moderate Use	606	1.66	0.20	19.68%	1.33	1.98
Low Use	42	0.36	0.36	166.90%	-0.24	0.95

8.3.4 Peak Coincidence

To calculate the peak coincidence factor (CF), the team used the same clean light logger dataset used for HOU estimates. Analysts calculated the peak coincidence factors based on the peak period: a summer peak from 5 to 6.30 PM, a winter peak from 7 to 8 AM, and a winter peak from 5 to 6 PM. Average CF was computed for each peak period for each logger and then a hierarchical model was developed to estimate CF.

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The weighted peak coincidence factor for Avista's peak period is 10.2% (Table 8-20). The CF for the winter 7-8am was calculated at 8.0%, while the 5-6pm winter peak CF was calculated at 14.4% and the 5-6:30pm summer peak CF is estimated at 9.1%.

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Table 8-20: Lighting Coincident Factor by Peak Period

Peak	CF Estimation	N	CF	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
Winter, 7-8 AM	Hierarchical Estimate, Robust SE	962	8.0%	0.01	22.74%	6.2%	9.8%
Winter, 5-6 PM	Hierarchical Estimate, Robust SE	962	14.4%	0.01	14.91%	12.3%	16.6%
Summer. 5- 6.30 PM	Hierarchical Estimate, Robust SE	962	9.1%	0.01	18.73%	7.4%	10.8%
Weighted Average	Hierarchical Estimate, Robust SE	962	10.2%	0.01	15.14%		

The evaluation team also estimated coincident factor by lamp type and room type. Findings are presented in Table 8-21 and Table 8-22, but it should be noted that the number of sample points among some variables is quite low (e.g. metered lamps in hallways), which lead to low confidence/precision estimates. The reader should be mindful of this uncertainty when interpreting the results.

Table 8-21: Coincident Factor by Peak Period by Lamp Type

Peak	Lamp Type (Logger Level)	N	CF	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
Winter, 7-8 AM	CFL	334	0.10	0.02	33.54%	0.06	0.13
	Incandescent	545	0.07	0.01	27.07%	0.05	0.08
	LED	83	0.16	0.06	60.40%	0.06	0.26
Winter, 5-6 PM	CFL	334	0.17	0.02	19.71%	0.13	0.20
	Incandescent	545	0.13	0.02	19.49%	0.10	0.15
	LED	83	0.22	0.04	29.24%	0.15	0.28
Summer, 5-6.30 PM	CFL	334	0.10	0.01	21.47%	0.08	0.12
	Incandescent	545	0.08	0.01	23.22%	0.06	0.10
	LED	83	0.13	0.03	32.78%	0.08	0.17

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Table 8-22: Coincident Factor by Peak Period by Room Type

Peak	Room Type (Logger level)	N	CF	Standard Error	Precision (90% confidence)	Lower Limit	Upper Limit
Winter, 7-8 AM	Kitchen	180	0.16	0.04	37.49%	0.10	0.23
	Dining	129	0.06	0.02	53.25%	0.03	0.10
	Living/Great/Family	134	0.09	0.02	31.31%	0.06	0.12
	Foyer/Hall/Stair	62	0.09	0.03	55.36%	0.04	0.14
	Bedroom	131	0.06	0.02	47.75%	0.03	0.09
	Toilet/Bathroom	131	0.10	0.03	42.21%	0.06	0.14
	Other	195	0.04	0.02	73.21%	0.01	0.06
Winter, 5-6 PM	Kitchen	180	0.31	0.04	21.03%	0.24	0.38
	Dining	129	0.22	0.04	31.27%	0.15	0.29
	Living/Great/Family	134	0.24	0.03	18.93%	0.20	0.29
	Foyer/Hall/Stair	62	0.12	0.03	42.75%	0.07	0.17
	Bedroom	131	0.08	0.02	33.77%	0.05	0.10
	Toilet/Bathroom	131	0.07	0.02	40.35%	0.04	0.09
	Other	195	0.11	0.02	30.02%	0.08	0.14
Summer, 5-6.30 PM	Kitchen	180	0.16	0.02	24.68%	0.12	0.20
	Dining	129	0.13	0.03	44.49%	0.07	0.18
	Living/Great/Family	134	0.09	0.02	32.93%	0.06	0.11
	Foyer/Hall/Stair	62	0.06	0.02	69.16%	0.02	0.10
	Bedroom	131	0.04	0.01	43.46%	0.02	0.06
	Toilet/Bathroom	131	0.11	0.02	30.86%	0.07	0.14
	Other	195	0.09	0.02	34.97%	0.06	0.12

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Appendix A Sampling and Estimation

The gross verified energy savings estimates presented in this report from Avista's electric DSM programs were generally determined through the observation of key measure parameters among a sample of program participants. A census evaluation would involve surveying, measuring, or otherwise evaluating the entire population of projects within a population. Although a census approach would eliminate the sampling uncertainty for an entire program, the reality is that M&V takes many resources both on the part of the evaluation team and the program participants who agree to be surveyed or have site inspections conducted in their home or business. When a sample of projects is selected and analyzed, the sample statistics can be extrapolated to provide a reasonable estimate of the population parameters. Therefore, when used effectively, sampling can improve the overall quality of an evaluation study. By limiting resource-intensive data collection and analysis to a random sample of all projects, more attention can be devoted to each project surveyed.

The nuances and tradeoffs considered by the evaluation team when developing sampling approaches varied across the portfolio and are discussed in more detail in Section 3.2. However, several common objectives were shared across sectors and programs. The most important sampling objective was representativeness – that is the projects selected in the evaluation were representative of the population they were selected from and will produce unbiased estimates of population parameters. A second key sampling objective was to consider the value of information being collected and align sample allocations accordingly. This effort generally involves considering the size (contribution to program savings) and uncertainty associated with the area being studied and making a determination about the appropriate level of evaluation resources to allocate.

The evaluation team used two broad classes of probability estimation techniques to make inferences about program or stratum performance based on the observations and measurements collected from the evaluation sample. Auxiliary information refers to the reported savings estimates stored in the program tracking system.

1) **Mean-Per-Unit** (or estimation in the absence of auxiliary information): This technique was used to analyze samples drawn from populations that are similar in size and scope. This approach was used primarily for residential programs that include a large number of rebates for similar equipment types where the evaluation objective is to determine an average kWh savings per rebated piece of equipment. With mean-per-unit estimation the average kWh savings observed within the sample is applied to all projects in the population.
2) **Ratio Estimation** (or estimation using auxiliary information): This technique was used for nonresidential programs and residential programs with varying savings across projects. This technique assumes that the ratio of the sum of the verified savings estimates to the sum of the reported savings estimates within the sample is

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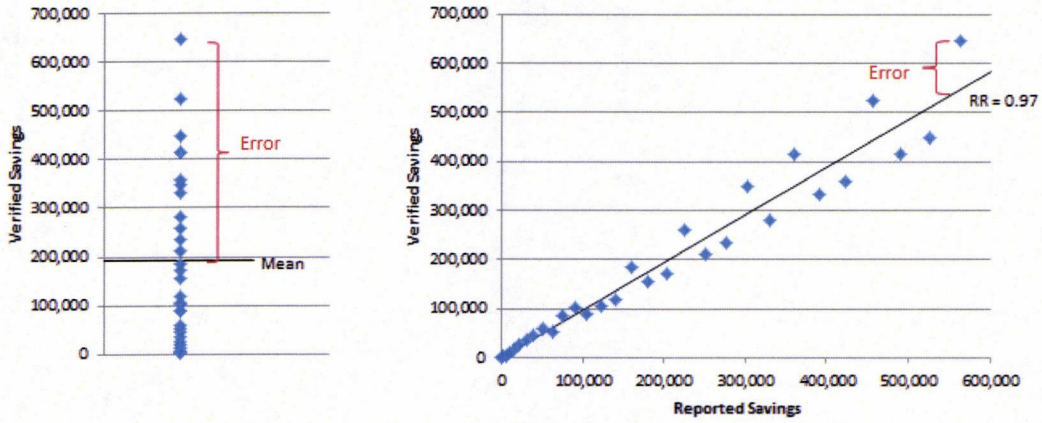
representative of the program as a whole. This ratio is referred to as the *realization rate*, or *ratio estimator*, and is calculated as follows:

Equation A- 1: Coefficient of Variation

$$Realization\ Rate = \frac{\sum_i^n Verified\ Savings}{\sum_i^n Reported\ Savings}$$

Where *n* is the number of projects in the evaluation sample. The realization rate is then applied to the claimed savings of each project in the population to calculate gross verified savings. Figure A- 1 shows the reduction in error that can be achieved through ratio estimation when the sizes of projects within a program population vary considerably. The ratio estimator provides a better estimate of individual project savings than a mean savings value by leveraging the reported savings estimate.

Figure A- 1: Comparison of Mean-Per-Unit and Ratio Estimation



For a measure such as the variable speed house fan, where each of the nearly 1,300 rebated units claimed an identical savings value of 439 kWh/year ratio estimation would offer no advantage over mean-per-unit estimation because there is no variability along the x-axis to leverage.

A.1 Stratification

The evaluation team used sample stratification with both classes of estimation techniques. Stratification is a departure from simple random sampling (SRS), where each sampling unit (customer/project/rebate/measure) has an identical likelihood of being selected in the sample. Stratified random sampling refers to the designation of two or more sub-groups (strata) from within a program population prior to the selection process. Whenever stratification was employed the evaluation team took great care to ensure that each sampling unit within the population belonged to one (and only one) stratum. In each program sample design where stratification was used, the probability of selection is different between strata and this difference must be accounted for when calculating results. The inverse of the selection probability is referred to as the *case weight* and is used in estimation of impacts when stratified random

samples are utilized. Consider the following simplified example in Table A- 1 based on a fictional program with two measures; refrigerators and clothes washers.

Table A- 1: Case Weights Example

Measure	Population Size	Sample Size	Case Weight
Clothes Washer	15,000	30	500
Refrigerator	6,000	30	200

Because refrigerators are sampled at a higher rate (1-in-200) than clothes washers (1-in-500), each sample point carries less weight in the program results than an individual clothes washer sample point. In general, the evaluation team designed samples so that strata with high case weights had low per-unit impacts or were well-understood measures. Low case weights were reserved for large and complex measures such as the large stratum of the Site Specific program.

The evaluation team felt that stratification was advantageous and utilized it in the sample design for a variety of reasons across the portfolio:

1) Increased precision if the within-stratum variability was expected to be small compared to the variability of the population as a whole. Stratification in this case allows for increased precision or smaller total sample sizes, which lowered evaluation costs.

2) To ensure that a minimum number of units within a particular stratum will be verified. This was relevant for small programs like ENERGY STAR® Homes. Although the program's contribution to portfolio savings was small, the evaluation team felt it was important to sample enough projects to independently estimate program performance.

3) It is easy to implement a value-of-information approach through which the largest projects are sampled at a much higher rate than smaller projects by creating size-based strata.

4) Sampling independently within each stratum allows for comparisons among groups. Avista and the evaluation team find value in comparing results between strata; e.g., comparing the realization rates between measures within a program.

A.2 Presentation of Uncertainty

There is an inherent risk, or uncertainty, that accompanies sampling, because the projects selected in the evaluation sample may not be representative of the program population as a whole with respect to the parameters of interest. As the proportion of projects in the program population that are sampled increases, the amount of sampling uncertainty in the findings decreases. The amount of variability in the sample also affects the amount of uncertainty introduced by sampling. A small sample drawn from a homogeneous population will provide a more reliable estimate of the true population characteristics than a small sample drawn from a

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heterogeneous population. Variability is expressed using the coefficient of variation (C_v) for programs that use simple random sampling, and an error ratio for programs that use ratio estimation. The C_v of a population is equal to the standard deviation (σ) divided by the mean (μ) as shown in Equation A- 2.

Equation A- 2: Coefficient of Variation

$$C_v = \frac{\sigma}{\mu}$$

When ratio estimation is utilized, standard deviations will vary for each project in the population. The error ratio is an expression of this variability and is analogous to the C_v for simple random sampling.

Equation A- 3 provides the formula for estimating error ratio.

Equation A- 3: Error Ratio

$$Error\ Ratio = \frac{\sum_{i=1}^{N} \sigma_i}{\sum_{i=1}^{N} \mu_i}$$

Equation A- 4 shows the formula used to calculate the required sample size for each evaluation sample, based on the desired level of confidence and precision. Notice that the C_v term is in the numerator, so required sample size will increase as the level of variability increases. For programs that rely on ratio estimation, error ratio replaces the C_v term in Equation A- 4. Results of the 2012-2013 portfolio evaluation were the primary source of error ratio and C_v assumptions for the evaluation.

Equation A- 4: Required Sample Size

$$n_0 = \left(\frac{Z * C_v}{D}\right)^2$$

Where:

n_0 = The required sample size before adjusting for the size of the population

Z = A constant based on the desired level of confidence (equal to 1.645 for 90% confidence two-tailed test)

C_v = Coefficient of variation (error ratio for ratio estimation)

D = Desired relative precision

The sample size formula shown in Equation A- 4 assumes that the population of the program is infinite and that the sample being drawn is reasonably large. In practice, this assumption is not always met. For sampling purposes, any population greater than approximately 7,000 may be considered infinite for the purposes of sampling. For smaller, or finite, populations, the use of a

finite population correction factor (FPC) is warranted. This adjustment accounts for the extra precision that is gained when the sampled projects make up more than about 5% of the program savings. Multiplying the results of Equation A- 4 by the FPC formula shown in Equation A- 5 will produce the required sample size for a finite population.

Equation A- 5: Finite Population Correction Factor

$$fpc = \sqrt{\frac{N - n_0}{N - 1}}$$

Where:

N = Size of the population

n_0 = The required sample size before adjusting for the size of the population

The required sample size (n) after adjusting for the size of the population is given by Equation A- 6.

Equation A- 6: Application of the Finite Population Correction Factor

$$n = n_0 * fpc$$

Throughout this report gross verified energy savings are reported with the associated margin of error. The margin of error can be introduced by sampling or via estimation error from a billing analysis, or both. Billing analyses rely on consumption data that often contains variability not explained by weather or other independent variables. This inherent variability in the data introduces uncertainty because program savings effects must be separated from underlying noise. The standard errors of coefficients in the regression model quantify this uncertainty and allow a margin of error to be calculated. Verified savings estimates always represent the point estimate of total savings, or the midpoint of the confidence interval around the verified savings estimate for the program. Equation A- 7 shows the formula used to calculate the margin of error for a parameter estimate.

Equation A- 7: Error Bound of the Savings Estimate

$$Error\ Bound = se * (z - statistic)$$

Where:

se =The standard error of the population parameter of interest (proportion of customers installing a measure, realization rate, total energy savings, etc.) This formula will differ according to the sampling technique utilized.

$z - statistic$ =Calculated based on the desired confidence level and the standard normal distribution.

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The 90% confidence level is a widely accepted industry standard for reporting uncertainty in evaluation findings. Unless otherwise noted, the confidence levels and precision values presented in this report are at the 90% confidence level. The z-statistic associated with 90% confidence is 1.645.

The evaluation team also reports the relative precision value associated with verified savings estimates. When evaluators or regulators use the term "90/10", the 10 refers to the relative precision of the estimate. The formula for relative precision shown in Equation A- 8:

Equation A- 8: Relative Precision of the Savings Estimate

$$Relative\ Precision_{Verified\ Savings} = \frac{Error\ Bound_{(kWh\ or\ kW)}}{Verified\ Impact_{(kWh\ or\ kW)}}$$

An important attribute of relative precision to consider when reviewing achieved precision values is that it is "relative" to the impact estimate. Therefore programs with low realization rates are likely to have larger relative precision values because the error bound (in kWh) is being divided by a smaller number. This means two programs with exactly the same reported savings and sampling error in absolute terms, with have very different relative precision values (example in Table A- 2).

Table A- 2: Relative Precision Example

Program	Reported kWh	Realization Rate	Error Bound (kWh)	Verified kWh	Relative Precision (90%)
Program #1	4,000,000	0.5	400,000	2,000,000	± 20%
Program #2	4,000,000	1.0	400,000	4,000,000	± 10%

In many cases a program-level savings estimate requires summation of the verified savings estimates from several strata. In order to calculate the relative precision for these program-level savings estimates, the evaluation team used Equation A- 9 to estimate the error bound for the program as a whole from the stratum-level error bounds.

Equation A- 9: Combining Error Bounds across Strata

$$Error\ Bound_{Program} = \sqrt{Error\ Bound^2_{Stratum1} + Error\ Bound^2_{Stratum2} + Error\ Bound^2_{Stratum3}}$$

Using this methodology, the evaluation team developed verified savings estimates for the program and an error bound for that estimate. The relative precision of the verified savings for the program is then calculated by dividing the error bound by the verified savings estimate.

Appendix B Lighting Interactive Factors

Table B- 1: Lighting Interactive Factors by Building Type and HVAC System Type

Building Type	Electric Resistance w/ Cooling	Electric Resistance w/o Cooling	Heat Pump w/ Cooling	Heat Pump w/o Cooling
Assembly	93%	82%	102%	91%
Automotive Repair	61%	61%	81%	81%
College or University	72%	53%	96%	77%
Exterior 24 Hour Operation	100%	100%	100%	100%
Hospital	29%	28%	65%	64%
Industrial Plant with One Shift	69%	61%	89%	81%
Industrial Plant with Three Shifts	69%	61%	89%	81%
Industrial Plant with Two Shifts	69%	61%	89%	81%
Library	72%	53%	96%	77%
Lodging	70%	60%	90%	80%
Manufacturing	69%	61%	89%	81%
Office <20,000 sf	72%	53%	96%	77%
Office >100,000 sf	93%	82%	102%	91%
Office 20,000 to 100,000 sf	93%	82%	102%	91%
Other Health, Nursing, Medical Clinic	93%	82%	102%	91%
Parking Garage	100%	100%	100%	100%
Restaurant	43%	41%	73%	71%
Retail 5,000 to 50,000 sf	73%	61%	93%	81%
Retail Anchor Store >50,000 sf Multistory	75%	57%	97%	79%
Retail Big Box >50,000 sf One-Story	86%	67%	103%	84%
Retail Boutique <5,000 sf	82%	69%	98%	85%
Retail Mini Mart	75%	61%	95%	81%
Retail Supermarket	86%	78%	97%	89%
School K-12	62%	52%	86%	76%
Street & Area Lighting (Photo Sensor Controlled)	100%	100%	100%	100%
Warehouse	61%	61%	81%	81%
Other	93%	82%	102%	91%

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Table B- 2: Lighting Interactive Factors by Building Type and HVAC System Type Cont.

Building Type	Gas, Oil, or Biomass w/o Cooling	Cooling w/o Heat	Refrigerated Space	None/ Exterior	Gas Heating Penalty Interaction (Therms/kW h saved)
Assembly	98%	111%	130%	100%	-0.0082
Automotive Repair	96%	100%	130%	100%	-0.0177
College or University	96%	119%	130%	100%	-0.0214
Exterior 24 Hour Operation	100%	100%	130%	100%	0
Hospital	93%	101%	130%	100%	-0.0328
Industrial Plant with One Shift	96%	108%	130%	100%	-0.0177
Industrial Plant with Three Shifts	96%	108%	130%	100%	-0.0177
Industrial Plant with Two Shifts	96%	108%	130%	100%	-0.0177
Library	96%	119%	130%	100%	-0.0214
Lodging	96%	110%	130%	100%	-0.0182
Manufacturing	96%	108%	130%	100%	-0.0177
Office <20,000 sf	96%	119%	130%	100%	-0.0214
Office >100,000 sf	98%	111%	130%	100%	-0.0082
Office 20,000 to 100,000 sf	98%	111%	130%	100%	-0.0082
Other Health, Nursing, Medical Clinic	98%	111%	130%	100%	-0.0082
Parking Garage	100%	100%	130%	100%	0
Restaurant	94%	102%	130%	100%	-0.0268
Retail 5,000 to 50,000 sf	96%	112%	130%	100%	-0.0177
Retail Anchor Store >50,000 sf Multistory	96%	118%	130%	100%	-0.0196
Retail Big Box >50,000 sf One-Story	97%	119%	130%	100%	-0.0150
Retail Boutique <5,000 sf	97%	113%	130%	100%	-0.0141
Retail Mini Mart	96%	114%	130%	100%	-0.0177
Retail Supermarket	98%	108%	130%	100%	-0.0100
School K-12	96%	110%	130%	100%	-0.0218
Street & Area Lighting (Photo Sensor Controlled)	100%	100%	130%	100%	0
Warehouse	96%	100%	130%	100%	-0.0177
Other	98%	111%	130%	100%	-0.0082

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Appendix C Billing Analysis Regression Outputs

C.1 HVAC Program

Table C- 1: ASHP Fixed-Effects Regression Output

```
Fixed-effects (within) regression               Number of obs      =      3826
Group variable: new_acct                        Number of groups   =       109

R-sq:  within  = 0.6350                         Obs per group: min =        20
       between = 0.0705                                        avg =      35.1
       overall = 0.4841                                        max =        37

                                                F(3,108)           =    193.04
corr(u_i, Xb)  = 0.0078                         Prob > F           =    0.0000

                                                (Std. Err. adjusted for 109 clusters in new_acct)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	2.953907	1.051504	2.81	0.006	.8696451	5.03817
hdd_ave	1.813402	.078876	22.99	0.000	1.657056	1.969747
c.hdd_ave#c.treatment	-.5409008	.0624757	-8.66	0.000	-.6647383	-.4170632
_cons	24.4846	1.284606	19.06	0.000	21.93829	27.03091
sigma_u	15.473174					
sigma_e	16.184346					
rho	.47754676	(fraction of variance due to u_i)				

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Table C- 2: Variable Speed Fan Motor Fixed-Effects Regression Output

```
Fixed-effects (within) regression               Number of obs      =     21036
Group variable: new_acct                        Number of groups   =       592

R-sq:  within  = 0.1426                         Obs per group: min =        19
       between = 0.0007                                        avg =      35.5
       overall = 0.0492                                        max =        37

                                                F(5,591)           =    168.92
corr(u_i, Xb)  = -0.0002                        Prob > F           =    0.0000

                                                (Std. Err. adjusted for 592 clusters in new_acct)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
cdd_ave	2.240237	.1093027	20.50	0.000	2.025568	2.454906
treatment	.7268809	.4911327	1.48	0.139	-.2376969	1.691459
c.cdd_ave#c.treatment	-.377199	.088024	-4.29	0.000	-.550077	-.204321
hdd_ave	.448729	.031888	14.07	0.000	.3861013	.5113567
treatment	0	(omitted)				
c.hdd_ave#c.treatment	-.0784601	.0243396	-3.22	0.001	-.1262627	-.0306575
_cons	22.42068	.6604954	33.95	0.000	21.12348	23.71788
sigma_u	17.550959					
sigma_e	11.904935					
rho	.68488454	(fraction of variance due to u_i)				

C.2 Low Income Program

Table C- 3: Low Income Fuel Switching

```
Fixed-effects (within) regression               Number of obs      =      2226
Group variable: account                         Number of groups   =        67

R-sq:  within  = 0.6476                         Obs per group: min =        25
       between = 0.0081                                        avg =      33.2
       overall = 0.5357                                        max =        60

                                                F(5,66)            =    107.35
corr(u_i, Xb)  = -0.0104                        Prob > F           =    0.0000

                                                (Std. Err. adjusted for 67 clusters in account)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	-.2237355	1.204884	-0.19	0.853	-2.629364	2.181893
cdd_ave	1.744057	.1989493	8.77	0.000	1.346842	2.141272
hdd_ave	1.71593	.0943928	18.18	0.000	1.527469	1.904392
c.cdd_ave#c.treatment	-.4636856	.1449925	-3.20	0.002	-.7531725	-.1741987
c.hdd_ave#c.treatment	-1.479525	.0896845	-16.50	0.000	-1.658586	-1.300464
_cons	15.72763	1.486092	10.58	0.000	12.76056	18.69471
sigma_u	11.082831					
sigma_e	14.797874					
rho	.35935317	(fraction of variance due to u_i)				

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Table C- 4: Low Income Electric Conservation

```
Fixed-effects (within) regression               Number of obs      =      5758
Group variable: account                         Number of groups   =       165

R-sq:  within  = 0.2724                         Obs per group: min =        26
       between = 0.0021                                        avg =      34.9
       overall = 0.1512                                        max =        70

                                                F(5,164)           =     52.86
corr(u_i, Xb)  = -0.0079                        Prob > F           =    0.0000

                                                (Std. Err. adjusted for 165 clusters in account)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	.0369547	1.036704	0.04	0.972	-2.010053	2.083963
cdd_ave	1.413486	.1614987	8.75	0.000	1.094601	1.732371
hdd_ave	1.000256	.083218	12.02	0.000	.8359395	1.164573
c.cdd_ave#c.treatment	-.0717039	.1136132	-0.63	0.529	-.296037	.1526293
c.hdd_ave#c.treatment	-.1048216	.0577246	-1.82	0.071	-.218801	.0091577
_cons	16.68617	1.478321	11.29	0.000	13.76717	19.60517
sigma_u	17.502397					
sigma_e	17.046712					
rho	.5131872	(fraction of variance due to u_i)				

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C.3 Shell Program

Table C- 5: Shell Rebate Measures

Fixed-effects (within) regression — Number of obs = 26568
Group variable: new_acct — Number of groups = 767

R-sq: within = 0.2066 — Obs per group: min = 24
between = 0.0197 — avg = 34.6
overall = 0.0908 — max = 36

F(5,766) = 145.62
corr(u_i, Xb) = -0.0086 — Prob > F = 0.0000

(Std. Err. adjusted for 767 clusters in new_acct)

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
treatment	-.3911459	.4069751	-0.96	0.337	-1.190065	.407773
cdd_ave	1.767326	.1030673	17.15	0.000	1.564998	1.969654
hdd_ave	.7466587	.0368662	20.25	0.000	.674288	.8190294
c.hdd_ave#c.treatment	-.0504493	.0170151	-2.96	0.003	-.0838509	-.0170476
c.cdd_ave#c.treatment	-.1390177	.0656922	-2.12	0.035	-.2679758	-.0100595
_cons	20.04061	.727349	27.55	0.000	18.61277	21.46844
sigma_u	17.860391					
sigma_e	14.751276					
rho	.59447877	(fraction of variance due to u_i)				

C.4 Fuel Efficiency Program

Table C- 6: Electric to Gas Furnace Conversion

```
Fixed-effects (within) regression               Number of obs      =      5792
Group variable: id                              Number of groups   =       173

R-sq:  within  = 0.5869                         Obs per group: min =        15
       between = 0.0952                                        avg =      33.5
       overall = 0.4080                                        max =        37

                                                F(5,172)           =    114.59
corr(u_i, Xb)  = 0.0217                         Prob > F           =    0.0000

                                                (Std. Err. adjusted for 173 clusters in id)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
hdd_ave	2.063256	.1090112	18.93	0.000	1.848084	2.278428
1.treatment	10.75073	1.607743	6.69	0.000	7.577283	13.92418
treatment#c.hdd_ave						
1	-1.687934	.1106144	-15.26	0.000	-1.906271	-1.469598
cdd_ave	2.511148	.2011141	12.49	0.000	2.114179	2.908117
treatment#c.cdd_ave						
1	-1.154795	.1769566	-6.53	0.000	-1.504081	-.8055084
_cons	13.8264	1.902086	7.27	0.000	10.07197	17.58084
sigma_u	18.416175					
sigma_e	17.166024					
rho	.53509083	(fraction of variance due to u_i)				

Table C- 7: Electric to Gas Water Heater Conversion

```
Fixed-effects (within) regression               Number of obs      =      2495
Group variable: id                              Number of groups   =        71

R-sq:  within  = 0.2691                         Obs per group: min =        21
       between = 0.0034                                        avg =      35.1
       overall = 0.1216                                        max =        37

                                                F(5,70)            =     26.87
corr(u_i, Xb)  = -0.0141                        Prob > F           =     0.0000

                                                (Std. Err. adjusted for 71 clusters in id)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
hdd_ave	.4577346	.0671164	6.82	0.000	.3238751	.5915941
1.treatment	-8.485181	1.34192	-6.32	0.000	-11.16156	-5.808806
treatment#c.hdd_ave						
1	-.1015656	.0723047	-1.40	0.165	-.2457728	.0426416
cdd_ave	1.617465	.3369514	4.80	0.000	.9454364	2.289493
treatment#c.cdd_ave						
1	.0304397	.210502	0.14	0.885	-.3893933	.4502726
_cons	26.45666	1.361088	19.44	0.000	23.74206	29.17127
sigma_u	14.212811					
sigma_e	11.201992					
rho	.61682752	(fraction of variance due to u_i)				

Table C- 8: Electric to Gas Furnace and Water Heater Conversion

```
Fixed-effects (within) regression               Number of obs      =      3475
Group variable: id                              Number of groups   =       102

R-sq:  within  = 0.6718                         Obs per group: min =        15
       between = 0.0034                                        avg =      34.1
       overall = 0.4474                                        max =        37

                                                F(5,101)           =    120.37
corr(u_i, Xb)  = -0.0355                        Prob > F           =    0.0000

                                                (Std. Err. adjusted for 102 clusters in id)
```

daily_kwh	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
hdd_ave	1.952949	.0842092	23.19	0.000	1.785901	2.119998
1.treatment	6.088577	1.855304	3.28	0.001	2.408154	9.769001
treatment#c.hdd_ave						
1	-1.627161	.0935052	-17.40	0.000	-1.81265	-1.441672
cdd_ave	2.659406	.1870938	14.21	0.000	2.288262	3.03055
treatment#c.cdd_ave						
1	-1.310611	.1920518	-6.82	0.000	-1.69159	-.9296322
_cons	14.03094	1.437596	9.76	0.000	11.17914	16.88275
sigma_u	18.025111					
sigma_e	15.327112					
rho	.58036822	(fraction of variance due to u_i)				

Appendix D Net to Gross Methodology and Findings

The evaluation team calculated net-to-gross (NTG) ratios for each program, using data collected from participant surveys. NTG takes into consideration the levels of both free ridership (FR) and spillover (SO). Free ridership refers to the portion of energy savings that participants would have achieved in the absence of the program through their own initiatives and expenditures (EPA, 2007).[39] Spillover refers to the program-induced adoption of measures by non-participants and participants who did not receive financial incentives or technical assistance for installations of measures supported by the program (EPA, 2007). The evaluation team used the following formula to calculate a NTG ratio for each program:

$$NTG = 1 - FR + SO$$

D.1 Free Ridership

Subtracting free ridership from gross savings produces an estimate of how much the program influenced participants to make the energy saving improvements that the program incents. Free ridership ranges from 0 to 1, with 0 being no free ridership (the program induced all of the reported gross savings), 1 being total free ridership (the program induced none of the savings) and values in between represent varying degrees of partial free ridership. The evaluation team used participant survey data to inform free ridership estimates.

With the exception of appliance recycling (which uses a different approach, explained below), free ridership consists of two components – change (FRC) and influence (FRI) – which both range from 0 to .5.

$$FR = FRC + FRI$$

Free Ridership Change (FRC)

Free ridership change is the participant's self-report of what they likely would have done if the program had not provided an incentive for their energy upgrade. To determine this, the evaluation team asked participant survey respondents FRC questions specific to the measures they installed. The question below exemplifies how the evaluation team collected FRC data.

*I'd like to ask a few questions about what you most likely would have done had you not received assistance from Avista for the **[Measure Type]**.*

Q1. Which of the following three alternatives is most likely: Would you have:

[SINGLE RESPONSE]

1. Put off buying a new **[Measure Type]** for at least one year [Includes repairing old or buying a used one.]
2. Bought a new **[Measure Type]** that was less expensive or less energy efficient.

39 The Environmental Protection Agency (EPA) (2007). Model Energy Efficiency Program Impact Evaluation Guide. Retrieved June 8, 2015 from http://www.epa.gov/cleanenergy/documents/suca/evaluation_guide.pdf.

3. Bought the exact same **[Measure Type]** anyway, and paid the full cost yourself.
[*Do not read:*]
-96. 96. Other, please specify: [OPEN-ENDED RESPONSE]
-97. 98. Don't know
-98. 99. Refused

The evaluation team then assigned the following FRC values to each respondent, based on their response to the question above, as shown in the Table D- 1.

Table D- 1: Free Ridership Change Values

Q1 Response	FRC Value
Put off buying a new [Measure Type] for at least one year [Includes repairing old or buying a used one.]	0.00
Bought a new [Measure Type] that was less expensive or less energy efficient.	0.25
Bought the exact same [Measure Type] anyway, and paid the full cost yourself.	0.50
Other	FRC values assigned on a case by case basis, depending on which pre-coded response item they most resemble
Don't know / Refused	0.25

Free Ridership Influence (FRI)

Free ridership influence represents how much influence the program had on a participant's decision to perform the incented energy upgrade. To determine this, the evaluation team asked participant survey respondents the following question:

Q2. Now I would like to ask about the influence that the program played in your decision to purchase the energy efficient **[Measure Type]**. I'm going to read a list of things that may have influenced your decision to buy the **[Measure Type]**. For each one, please indicate how much of an influence it played in your decision, where '1' means it was "not at all influential" and "5" means it was "extremely influential." Let me know if an item doesn't apply to you. *[Interviewer: do not read 97-99]*

[MATRIX QUESTION: SCALE]

[LOGIC] Item	1	2	3	4	5	97 NA	98 DK	99 RF
[IF INCENTIVE = REBATE] The rebate you received								
Information on Avista's website								
Advertising and other information from Avista								
A salesperson or contractor								

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Anything else, please specify:_____ _								

The evaluation team then selected the highest rated program-attributable item for each respondent and assigned the following FRI scores, depending on their high score value (Table D- 2).

Table D- 2: Free Ridership Influence Values

Influence Rating	FRI Value
1	0.500
2	0.375
3	0.250
4	0.125
5	0.000
Don't know / Refused	Sector-level measure average

Program-Level Free Ridership

The evaluation team summed FRC and FRI scores for each respondent, yielding participant-level free ridership (FR) scores. The evaluation team used the participant-level FR scores to calculate a savings-weighted average FR score for each program, which serves as the program-level FR score.

Appliance Recycling Free Ridership

The evaluation team developed an approach to calculating net savings for the Appliance Recycling Program by applying the Department of Energy Uniform Methods Project's (UMP) methodology. The UMP methodology differs from the NTG methodology for other program types. Rather than first calculating a NTG value from survey responses and then applying that to gross savings to yield net savings, the UMP methodology first calculates net savings using jurisdiction-specific data on the energy consumption of new and recycled appliances, together with survey data on the participants' decision-making.[40]

Adding estimated spillover to the net savings and dividing that sum by the program-reported gross savings yields the NTG ratio.[41] The evaluation team developed a modified approach that

[40] See *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures*, Chapter 7: "Refrigerator Recycling Evaluation Protocols, National Renewable Energy Laboratory," March 2013 (Download available at: http://www1.eere.energy.gov/wip/pdfs/53827-7.pdf).

[41] The rationale for the UMP approach is that the actual gross savings for a particular participant depends on whether or not the participant replaced the recycled unit with a new one. Replacing the recycled unit with a new one yields gross savings equal to the energy consumption of the recycled unit minus the energy consumption of the replacement unit. Recycling without replacement yields gross savings equal to the entire energy consumption of the recycled unit. The net savings thus account for the level of free ridership as well as the mix of replaced and non-replaced appliances.

did not require estimates of the average consumption of new and recycled appliances. Surveyed participants reported what they would have done absent the program, and the evaluation team assigned a free ridership value to each respondent based on the latter information (Table D- 3).[42]

Table D- 3: Appliance Recycling Modified FR Values

Scenario	FR Value
The participant would not have recycled appliance without the program	0.000
Without the program, the participant would have sold or given away appliance for use in another home. Some of those would have been removed from the grid, some not.*	0.375
Without the program, the participant would have disposed of the appliance in a way that removed it from the grid.	1.000

* The UMP methodology assumes that half the units would have been taken off the grid without replacement, one-quarter of the units would have been taken off the grid with replacement, and one-quarter of the units would not have been taken off the grid. The evaluation team assigned free ridership values of 0, .5, and 1.0 to those three subgroups, respectively.

The evaluation team used the participant-level FR scores to calculate a savings-weighted average FR score for the appliance recycling program, which serves as the program-level FR score.

D.2 Spillover

Spillover estimates the energy savings from non-rebated energy improvements made outside of the program that are influenced by the program, and can be used to adjust gross savings by the additional energy savings garnered and the level of attribution the program is able to claim for these non-rebated measures. A spillover value of 0 equates to no spillover and values greater than 0 demonstrate the existence and magnitude of spillover.[43] The evaluation team used participant survey data to estimate spillover.

The evaluation team asked participant survey respondents to indicate what energy saving measures they had implemented since participating in the program to identify potential spillover. The evaluation team then asked participants to use a 1 to 5 scale, where 1 means "not at all influential" and 5 means "extremely influential," to indicate how much influence the Avista program had on their decision to purchase these additional energy saving measures. Table D- 4 exhibits how much program influence, ranging from 0% to 100%, is associated with each scale response to the spillover influence question.

[42] The surveyed respondents also reported whether they did or did not replace the recycled appliance. However, the information on replacement or non-replacement did not enter the free ridership equation, as that only indicates the amount of gross savings possible.

[43] Spillover values can be interpreted as percentages, where 1=100%. Thus, a spillover value of .5 would mean that spillover savings were 50% of program gross savings.

Table D- 4: Participant Spillover Program Influence Values

Reported Avista Program Influence	Influence Value
1	0.0
2	0.0
3	0.5
4	1.0
5	1.0

The evaluation team used the influence value to calculate the participant measure spillover (PMSO) for each spillover measure that each participant reported. Participant measure spillover is calculated as follows, with the deemed measure savings values based on the evaluation teams estimate of the savings for the implemented measure:

$$PMSO = Deemed\ Measure\ Savings * Influence\ Value$$

The evaluation team then summed all PMSO values associated with each program and divided them by the sample's gross program savings to calculate the spillover estimates for each program:

$$Program\ SO = \frac{\sum Program\ PMSO}{\sum Sample's\ Gross\ Program\ Savings}$$

D.3 Residential Lighting Net to Gross

The estimated free ridership impacts of the residential lighting program—in which a customer likely replaced an expired, efficient technology with a like technology—was calculated by constructing a market baseline. The evaluation team developed this baseline by examining the composition of lamp types found from onsite inspections in the lighting study, respective EISA equivalent baselines, and efficient case wattage to determine the free ridership market effects. The evaluation team's methodology is consistent with the RTF, but values are based on primary data collection from Avista's service territory.

The market share for each lamp technology was determined from the Avista residential lighting hours–of-use study, in which the existing shares of installed lamps by technology type were inventoried during onsite inspections; see Table 8-5. For the purposes of assessing the market baseline for the residential lighting program, the market shares needed to be normalized for screw-in sockets only. For example, the market share for CFL lamps increased from 23.8% to 26.9% once only screw-in sockets were included. The CFL market share from onsite inspections is supported by the data from the NEEA 2014–2015 Northwest Residential Lighting Long-Term Market Tracking Study[44], which listed the estimated CFL market share as 28%.

[44] https://neea.org/docs/default-source/reports/northwest-residential-lighting-long-term-market-tracking-study.pdf?sfvrsn=4

To determine the adjusted market baseline for screw-in lamps, the evaluation team multiplied the market share by the typical technology wattage for each type. To illustrate the approach, Table D- 5 provides a summary of the calculation to estimate the market baseline for a 60-watt equivalent A-lamp.

Table D- 5: Example Market Baseline 60-watt Equivalent Lamp

Technology Type	Market Share of Screw-in Sockets	Typical Technology Wattage	Contribution to Market Baseline Wattage
CFL	26.9%	13	3.5
Incandescent	60.8%	43*	26.1
Halogen	4.4%	43*	1.9
LED	7.9%	9.5	0.8
TOTAL	**100%**		**32.3**

* The technology wattage for incandescent and halogen lamps was set to the applicable lumen bin EISA standard.

In this example, the market baseline reduced the savings baseline from the EISA standard wattage of 43, to the market baseline of 32.3W—a 24.9% reduction of the baseline wattage. This in turn reduced the gross energy savings impacts by the same percentage reduction. The evaluation team followed this approach to uniquely calculate and aggregate each lumen bin and product type.

The net to gross ratio for the residential lighting program was 64.5% as shown in Table D- 6.

Table D- 6: Residential Lighting Net to Gross Ratios and Net Verified Impacts

	Reported Savings (kWh)	Realization Rate	Gross Verified Savings (kWh)	Net to Gross Ratios	Net Verified Savings (kWh)
Simple Steps—LED	4,308,734	125.2%	5,394,253	65.9%	3,557,152
Simple Steps—CFL	14,866,096	132.5%	19,701,850	64.1%	12,623,297
Simple Steps – NP—LED	14,877	199.3%	29,644	65.9%	19,548
Simple Steps – N—CFL	165,598	159.7%	264,478	64.1%	169,456
Giveaway—CFL	3,660	200.5%	7,338	65.9%	4,839
Giveaway—LED	9,995	446.6%	44,637	64.1%	28,600
TOTAL	**19,606,228**	**131.0%**	**25,689,564**	**64.5%**	**16,561,380**

D.4 Net to Gross Findings

The tables below outline the free ridership, spillover, and NTG values estimated for each program.

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Table D- 7: Nonresidential Program Net To Gross Ratios

Program	FR (savings weighted)	Spillover	NTG
Nonresidential Electric			
Site Specific	58%	0.4%	58%
Prescriptive Lighting	37%	3%	66%
EnergySmart Grocer	NA	0%	NA
Prescriptive Non-Lighting Other	24%	6%	82%

Table D- 8: Residential Program Net To Gross Ratios

Program	FR (savings weighted)	Spillover	NTG
Residential Electric			
Appliance Recycling	75%	0%	26%
ENERGY STAR Homes	67%	0%	33%
Fuel Efficiency	27%	0%	73%
HVAC	54%	0%	46%
Shell	45%	0%	55%
Water Heat	74%	0%	26%

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Appendix E Residential Lighting Logger Study Forms

E.1 Lighting Inventory Form

RESIDENTIAL LIGHTING HOURS OF USE STUDY: ON-SITE SURVEY FORM

Customer ID: _____

Customer Name: _____ Visa Card #: _____

Contact Phone: _____ Email: _____

Address: _____

City, State, Zip: _____

Engineer: _____

Site Visit Date/Time: _____

Notes: _____

Survey Key

N/A = Not Applicable

NX = Not Available

Site Information

1. Premise Type: _____
   (Single-family detached: 1 unit, Single-family attached: 2 units, Multi-family: 3+ units, Mobile Home, Other – specify)
2. Ownership Status: _____
   (Own, Rent, Other – specify)
3. How heating fuel: _____
   (electric, gas, oil, pellets, wood)
4. Home heating equipment type: _____
   (Furnace, Baseboard, Heat Pump, Other – specify)
5. Home Air Conditioning Equipment Type: _____
   (Central Air, Window A/C, Fan, Other – specify, None)
6. Estimated number of portable electronic devices used in the house (e.g. iPhone, Tablet computers, Kindles, etc.)?: _____
7. Home Square Feet (approx.): _____
8. Year Home Constructed: _____

Program Participant Info

9. Does the customer recall receiving a free box of lights from Avista in 2012? (Y/N/DK): _____
10. If so, did the customer install those lights (Y/N/DK)?: _____

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Room Type ID Table

Room #	Room Type	Room Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Room Type:		
1= Kitchen	6= Utility/Laundry Room	12= Garage
2= Dining Room	7 = Master Bedroom	13= Mech/Electrical Room
3= Living/Family/Great Room	8 = Bedroom	14= Closet/Storage
4= Office	9 = Toilet/Bathroom	15=Exterior
5= Foyer/Hallway/Stairway	10= Basement	16= Other, specify
	11= Attic	

Lighting Inventory & Logger Placement Customer ID:

Room Number:	Room Type:	Room Description (e.g Master Bath):	Circuit Type:

	Fixture Qty	Socket Type	Sockets/Fixture	Lamp Type	Lamp Shape	Lamp Qty/Fixture	Watts/Lamp	# Burnout	Logger Placed?
Fixture #1 Type:									
Fixture #2 Type:									
Fixture #3 Type:									
Fixture #4 Type:									
Fixture #5 Type:									

Logger Type:
Logger Serial #:
Ambient Light (Y/N)?
Time Logger Placed:
Window Orient (E, W, N, S):
Notes on Location: (Be detailed)

Room Number:	Room Type:	Room Description (e.g Master Bath):	Circuit Type:

	Fixture Qty	Socket Type	Sockets/Fixture	Lamp Type	Lamp Shape	Lamp Qty/Fixture	Watts/Lamp	# Burnout	Logger Placed?
Fixture #1 Type:									
Fixture #2 Type:									
Fixture #3 Type:									
Fixture #4 Type:									
Fixture #5 Type:									

Logger Type:
Logger Serial #:
Ambient Light (Y/N)?
Time Logger Placed:
Window Orient (E, W, N, S):
Notes on Location: (Be detailed)

Room Number:	Room Type:	Room Description (e.g Master Bath):	Circuit Type:

	Fixture Qty	Socket Type	Sockets/Fixture	Lamp Type	Lamp Shape	Lamp Qty/Fixture	Watts/Lamp	# Burnout	Logger Placed?
Fixture #1 Type:									
Fixture #2 Type:									
Fixture #3 Type:									
Fixture #4 Type:									
Fixture #5 Type:									

Logger Type:
Logger Serial #:
Ambient Light (Y/N)?
Time Logger Placed:
Window Orient (E, W, N, S):
Notes on Location: (Be detailed)

Room Number:	Room Type:	Room Description (e.g Master Bath):	Circuit Type:

	Fixture Qty	Socket Type	Sockets/Fixture	Lamp Type	Lamp Shape	Lamp Qty/Fixture	Watts/Lamp	# Burnout	Logger Placed?
Fixture #1 Type:									
Fixture #2 Type:									
Fixture #3 Type:									
Fixture #4 Type:									
Fixture #5 Type:									

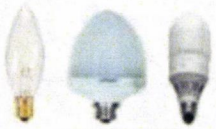
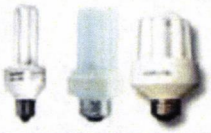
Logger Type:
Logger Serial #:
Ambient Light (Y/N)?
Time Logger Placed:
Window Orient (E, W, N, S):
Notes on Location: (Be detailed)

Room Number:	Room Type:	Room Description (e.g Master Bath):	Circuit Type:

	Fixture Qty	Socket Type	Sockets/Fixture	Lamp Type	Lamp Shape	Lamp Qty/Fixture	Watts/Lamp	# Burnout	Logger Placed?
Fixture #1 Type:									
Fixture #2 Type:									
Fixture #3 Type:									
Fixture #4 Type:									
Fixture #5 Type:									

Logger Type:
Logger Serial #:
Ambient Light (Y/N)?
Time Logger Placed:
Window Orient (E, W, N, S):
Notes on Location: (Be detailed)

Lamp Shape Lookup Table

Bulb Style	Code	Image	Bulb Style	Code	Image
1. Standard/ Pear/candelabra (A-lamp)	1		5. Spot/ reflector/ Flood light (typical in can lights)	5	
2. Twist/ spiral	2		6. Circline	6	
3. Globe (typical for bathroom vanity)	3		7. Bullet/torpedo	7	
4. =Bug light (yellow/blue/red color)	4		8. Tube	8	

Room Type:			
1= Kitchen	5= Foyer/Hallway/Stairway	9= Toilet/Bathroom	13= Mech/Electrical Room
2= Dining Room	6= Utility/Laundry Room	10= Basement	14= Closet/Storage
3= Living/Family/Great Room	7= Master Bedroom	11= Attic	15=Exterior
4= Office	8= Bedroom	12= Garage	16= Other, specify

Circuit Type:	
1= On/Off (switch, plug, pull string, etc.)	5= Timer
2= Dimmer	6= 3-way
3= Motion/Photo Sensor	7= Other, specify
4 = Remote Control	

Socket Type:	
1= Medium Screw Base (standard)	4= Pin Base
2= Small Screw Base (candelabra)	5= GU Base
3= Large Screw Base (mogule)	6= Other, specify

Fixture Type:		
1= Lamp (floor/table downlight)	5= Ceiling surface mounted	9= Under cabinet
2= Torchiere (floor uplight)	6= Track Lighting	10= Garage Door light
3= Wall-mounted (sconce, vanity)	7= Suspended (chandelier)	11= Other, specify
4= Ceiling Fan Light	8= Recessed (can light)	

Lamp Type:	
1= Incandescent	5= Linear fluorescent
2- CFL	6= Other, specify
3= LED	7=Empty socket
4= Halogen/Quartz	

Lamp Shape		
1=Standard/Pear/Candelabra/A-lamp	5=Spot/Reflector/Flood	9=Other, specify
2=Twist/Spiral	6=Circline	
3=Globe	7=Bullet/Torpedo	
4=Bug light	8=Tube	

Logger Type:	
1= U9-002 Light On/Off	3= U12-012 Temp/RH/Light Int.
2= UX90-002 Light On/Off (w/Display)	4=UX90-002 w/Light Pipe

E.2 Recruitment Materials

June 30, 2015

Dear <customer>,

Avista Utilities is conducting a residential lighting study in the homes of our customers. You have randomly been selected as a potential participant. In order to better understand how our customers use energy and improve our lighting rebates programs for customers like you, Avista Utilities has retained Nexant, an expert in the energy efficiency evaluation field, to conduct a lighting study on our behalf to measure how many hours per day customers are using lights in various areas of their homes.

We would like to offer you the opportunity to participate in this study. Participation is voluntary and participants of the study will receive **$75 in pre-paid Visa gift cards**. If you are interested in participating, or would like more information, please call **1-855-828-7745** to speak to a Nexant representative. Please reference your Study ID: **<study id>**.

Availability is limited, so participants will be admitted on a first-come, first-serve basis. If you decide to participate in the study, an appointment will be scheduled at your earliest convenience for a Nexant evaluator to visit your home and install 4 to 8 small light measuring devices ("loggers") which measure only the amount of time the lights are turned on. A follow-up appointment will be scheduled in approximately six months for the loggers to be collected.

The results of this study will help us understand how our customers use their lights so that we can improve our energy efficiency programs in the future. If you have any questions about the study, please give me a call.

In addition, Avista Utilities offers several Residential rebates including;

- High Efficiency Equipment (Furnace, Boiler, Variable Speed Motors, Smart Thermostats)
- Insulation (Attic, Wall, Floor)
- Windows
- Space & Water Heat conversions from Electric

For a complete list of rebates and requirements, application forms or to submit an online application go to www.avistautilities.com/resrebates. Or you can contact rebates@avistautilities.com or 800-227-9187 with questions.

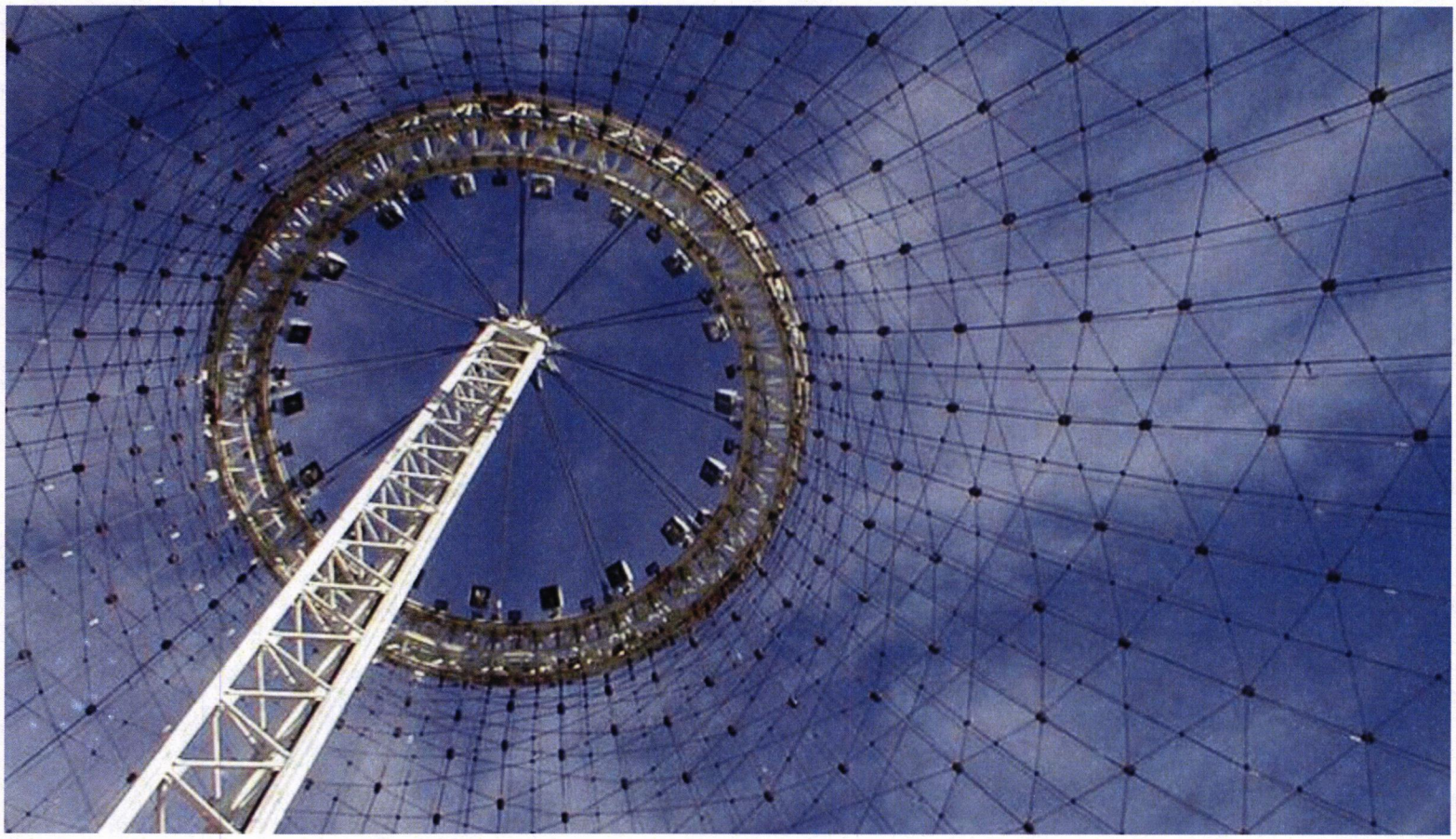
Thank you again for your willingness to participate.

Sincerely,

David Schafer -DSM Program Manager
Avista Utilities – P: 509-495-4688 E: David.Schafer@avistacorp.com

Nexant
Reimagine tomorrow.

research into action inc



Process Evaluation of Avista's 2014-2015 Energy Efficiency Programs

Submitted to Avista Utilities
May 26, 2016

Principal authors:

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1 Executive Summary

Nexant Inc. and Research Into Action (collectively the evaluation team) conducted an impact and process evaluation of Avista's 2014-2015 residential and nonresidential energy efficiency programs. This report documents findings from the process evaluation activities. The main purpose of the process evaluation was to identify any improvements needed at the portfolio level to increase program effectiveness and efficiency. The evaluation team conducted the evaluation by reviewing program data and through interviews and surveys with various market actors. Table 1-1 lists the data collection activities and key topics covered by each data source.

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Table 1-1: Overview of Data Collection Activities

Data Source (Sample by sector)	Type	When	Analytic Techniques	Key Topics
Staff (16; 4 nonres. and 12 res.)	Interview	Feb. 2015, & Oct. 2015	Qualitative, thematic	▪ Program goals and processes ▪ Communication and coordination ▪ Data tracking ▪ Future program opportunities ▪ Outreach
Implementers (7; 1 nonres. and 6 res.)	Interview	Oct. 2015	Qualitative, thematic	
Contractors (82; 29 nonres. and 53 res.)	Survey	Aug. 2015, Oct. 2015	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Satisfaction ▪ Motivations to participate ▪ EE Sales practices ▪ Net-to-Gross
Participants (680; 305 nonres. and 339 res.)	Survey	May 2015 – Feb. 2016	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Satisfaction ▪ Program experience ▪ Net-to-Gross ▪ Commercial uptake of Simple Steps products
Nonparticipants (140; 70 nonres. and 70 res.)	Survey	Oct. – Nov. 2015	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Experience with EE ▪ Commercial uptake of Simple Steps products ▪ Spillover
Retailers (27)	Survey	Jan. 2016	Quantitative	▪ Commercial uptake of Simple Steps products
Small Business staff and implementer (2)	Interview	December 2015	Qualitative, thematic	▪ Program goals and requirements ▪ Communication and coordination ▪ Marketing ▪ Implementation
Small Business installers (2)	Interview	December 2015	Qualitative, thematic	▪ Role in outreach ▪ Data collection and reporting ▪ Challenges and barriers to participation ▪ Implementation successes
Small Business participants (34)	Survey	January 2016	Quantitative, univariate and bivariate frequencies	▪ Program experience ▪ Satisfaction ▪ Future EE plans ▪ Business characteristics
Database analysis	Database review	Feb. 2015 – April 2016	Quantitative	▪ Identify participation patterns ▪ Number of repeat participants ▪ Assess HER+rebate savings

The 2014-2015 evaluation shows high levels of program awareness among all of Avista's customers and shows high levels of satisfaction among program participants and contractors. Program participants and contractors were complementary of Avista staff and generally appreciated the opportunities to save money, save energy, and improve their properties that the programs provide. The evaluation also shows that there are areas the programs could enhance to make them better able to respond to the ever changing market conditions in which these programs operate.

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The results of the process evaluation identified the following key findings, organized by sector and by theme. Conclusions and recommendations follow the key findings.

1.1 Nonresidential Key Findings

1.1.1 Program Participation, Awareness and Involvement

- **Program participation declined over the last few years, especially in lighting.** The change to a T8 baseline lowered incentives available for T12 upgrades negatively effecting participation.
- **The Energy Smart Grocer market may need to be expanded to boost participation.** Staff reported that Energy Smart Grocer has seen diminished savings over the last few years due to the market getting saturated. Program staff is seeking new markets, such as restaurants and other food service establishments, to boost participation but that segment alone may not singularly compensate for the savings decline.
- Contractors play a notable role in the acquisition of projects, the implementation of projects, and in informing customers about rebates. More than half of contractors reported they play a key role in initiating upgrades and communicating rebate opportunities to customers. Customer's awareness of the program through contractors was associated with an increased likelihood of program participation, and contractors appear to be playing a larger role in preparing applications than in years past.

1.1.2 Influences on Customers Decision Making

- **Having a corporate culture that prioritizes energy savings appears associated with current participation.** Participants are twice as likely as nonparticipants to report having an energy saving policy or practice in place.
- Survey results show that saving money, improving operations and maintenance, and improving the comfort of facilities are key motivators to participation. Contractors and participants report that saving money motivates customers to participate. According to contractors, improving operations and maintenance also was an important motive of customers. There is also some evidence that improving the comfort of one's building is an important motivation for participants that implemented a gas project.

1.1.3 Program Experience

- **Participants were largely satisfied with Avista's programs.** The large majority of participants reported high levels of satisfaction with program elements such as the time it took to apply, the variety of equipment available, and the quality of the products received. A minority of participants could not rate their satisfaction with their project's energy savings so soon after project completion.
- **Contractors and participants reported high satisfaction with their interactions with program staff.** Most participants sought assistance from staff regarding their application compared to any other topics.
- **Contractors are not engaged or knowledgeable about Avista's marketing efforts.** Among contractors, the quality, and quantity of Avista's marketing received lower satisfaction scores than any other program element.

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- **Contractors value Avista's rebates but there is an opportunity to use the programs to train contractors.** Contractors reported they value Avista's rebates to help them sell jobs and push customers to install more efficient equipment.

1.1.4 Opportunities for Increasing Program Participation

- **Planned equipment upgrades create opportunities for continued program-related savings.** Almost a third of nonparticipants reported they will make an upgrade in the next two years that could involve an efficiency upgrade, and the majority of those reported they would make a lighting upgrade.

1.1.5 Commercial Uptake of Simple Steps Measures

- **Customers are installing Simple Steps items in commercial buildings.** Survey results show that between 5 and 12% of Simple Steps CFLs and about 12% of Simple Steps LEDs are purchased for implementation in commercial properties.

1.1.6 Small Business Key Findings

- **The program is running smoothly.** The program is meeting its overall goals for measure installation and savings and there were no reports of any systemic problems with interval communication or administration.
- **There is an opportunity to improve the efficiency of small businesses, particularly in the lighting area**. Program data shows and installers reported ample opportunity in the market to replace T12s. More than a third of 2015 participants had T12 fixtures.
- **Staff and participants reported high levels of satisfaction with the measures and services provided by the program**. Very few participants reported removing any of the installed measures on their own, however the impact evaluation activities did find that a relatively significant number of participants surveyed did remove on their own at a later time.
- **The outreach model of the program provides Avista with an opportunity to develop relationships with their customers and engage customers about other program opportunities**. Installers often tell participants about energy saving actions they could take outside of the scope of the program. Most upgrade recommendations pertained to lighting and about a third of participants said they plan on making a lighting upgrade in the next year.

1.2 Residential Key Findings

1.2.1 Program Delivery

- **Although rebate programs are running smoothly, there is an opportunity to engage contractors more with Avista's programs.** Avista primarily interacts with contractors when contractors call to request information on behalf of their customers. Avista does not currently offer any formal training for contractors on the rebate programs, and Avista staff only occasionally visit contractor offices to hand out rebate information, the only face-to-face outreach activity reported by program staff.

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- **Rebates are an effective sales tool for contractors.** Most contractors agreed that they always tell customers about rebates and that the rebates help them sell more energy efficient equipment and services to their customers, a finding that is supported by Avista staff.
- **Simple Steps, Smart Savings, Opower Home Energy Reports, and Low-income are running smoothly.** There were no reports of systemic problems with recruitment, communication, and implementation. Challenges encountered mainly revolved around customer databases. For example, smaller retailers in the Simple Steps, Smart Savings program struggle with reporting sales data because they lack a sophisticated reporting system that larger retailers typically have and Opower was unable to send Home Energy reports for about six months in 2015 when Avista changed its customer billing system in January/February 2015.

1.2.2 Awareness and Familiarity with Avista's programs

- **Contractors were aware and familiar with Avista's programs.** More than three-quarters of residential contractors reported completing projects that received Avista rebates for at least the past five years. Contractors also spent considerable time working on Avista-rebated projects.
- **Avista's marketing efforts are working in generating customer awareness.** The source of program awareness among customers is consistent with Avista's marketing activities. Of the nonparticipants who were aware of Avista incentives (41% of the sample), about half (45%) reported learning about Avista's rebate programs through channels Avista used for outreach.
- **Participants highlighted the importance of contractors in advertising Avista's programs.** Contractors were the main source of awareness for participants. Awareness through a contractor was greater than any other source and was by far the greatest predictor of program participation.
- **Awareness of other Avista programs among participants varied.** Fewer than half of surveyed participants were familiar with other energy efficiency rebate opportunities from Avista (besides the program in which they had participated) and this varied by program. Highest awareness was among Water Heat and Fuel Efficiency participants and lowest among ENERGY STAR Homes participants.

1.2.3 Program Experience

- **Participants were satisfied with the rebate programs.** More than four-fifths (84%) of surveyed participants reported their overall satisfaction with their Avista rebate program experience as being either "very" or "completely" satisfied.
- **Contractors satisfaction with the rebate programs varied.** Most (80-85%) contractors reported being satisfied with the length of time needed to complete the paperwork and range of qualifying products. The majority (67%) were satisfied with Avista website and about half (54%) reported being satisfied with the rebate amounts.
- **Contractors are unfamiliar with Avista's marketing efforts.** Contractors provided the lowest satisfaction ratings on the marketing aspects of the rebate programs. About one-tenth (11%) indicated they were dissatisfied with the amount of Avista's marketing and

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nearly one-tenth (9%) noted they were dissatisfied with the quality of marketing. However, in their follow-up comments, these contractors indicated they were largely unaware of Avista's marketing efforts or only saw the materials sporadically, indicating that contractors may be more unfamiliar with Avista's marketing of the rebate programs than they are dissatisfied.

- **Nearly all rebate participants found program-related information clear.** A majority of participants reported that program-related information (e.g., website or rebate form) was clear on how to apply for a rebate, which equipment qualified for a rebate, expected energy savings of program eligible equipment, and who to contact if any issues arose. Program materials were less clear about the quality assurance process and regarding which equipment or items qualified for rebates for Shell participants than for other program participants.
- **Both participants and nonparticipants expressed interest in receiving additional information on Avista's program offers.** About three-quarters (77%) of participants and more than half (59%) of nonparticipants reported being interested in receiving energy-saving and/or program information from Avista.
- **Home Energy Reports can be effective at engaging customers and motivating them to take action** such as participating in Avista's rebate programs, such as the Fuel Efficiency program. These findings validate Avista's strategy to promote the rebate programs via the home energy reports.

1.2.4 Motivations and Barriers to Participation

- Top three motivations for participating in Avista's rebate programs were: increased comfort, saving energy, and saving money. Between 83-88% of participants reported these three motivations for participation.
- Up-front cost was the most frequently cited barrier to completing an energy efficiency upgrade by nonparticipants. This indicates an importance of offering an incentive to customers for home improvement projects.
- **The second most frequently cited barrier was living in a rental property.** Nonparticipants reported that living in a rental property prohibits them from making improvements to their home. Demographic analysis revealed that 27% of surveyed nonparticipants and 3% of surveyed participants were renters.

1.2.5 Participation Trends

- **Participation in Avista's residential rebate programs increased in the last two years.** The number of rebates declined sharply from 2010 to 2013, and then increased by 51% from 2013 to 2014 and by 43% from 2014 to 2015. Note that the evaluation team only examined the number of rebates for these six measures: 1) ENERGY STAR appliances, 2) shell, 3) HVAC, 4) fuel conversions (or Fuel Efficiency program), 5) water heater, and 6) ENERGY STAR Homes measures. Shell measure rebates, in particular, increased by 507% from 2013 to 2014. The decline in the overall number of rebates examined from 2010 to 2013 was related to the discontinued rebates for appliance measures, which accounted for 17,332 of the total decline of 23,453 measures.

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1.2.6 Future Opportunities

- Program delivery actors suggested that ductless heat pumps, water heating measures, and plug load technologies could be an opportunity for Avista. Contractors provided suggestions for additional equipment they would like rebated through the programs, and ductless heat pumps and hot water saving measures were the most commonly cited. The CLEAResult representative listed several technologies that Avista could consider if they wanted to add measure to the program: advanced power strips, new lighting controls, water heaters, and ductless heat pumps.
- **An Opower representative suggested several customer engagement program opportunities:** 1) adding a monthly email report on top of the mail report; 2) alerting customers of their bills (if high); 3) offering customers a "points and rewards" option where they can collect points based on how much energy they save and redeem those points for a gift card; and 4) targeting small and medium businesses or low-income customers with the reports.
- **The Community Action Partners who deliver the low-income program for Avista also provided several suggestions:** 1) offering more in-depth education about saving energy such as offering a class to customers; 2) providing more funds for safety and health measures; 3) providing some funding for renewable measures.

1.3 Conclusions and Recommendations

The evaluation team concluded the following and provides several suggestions for Avista's programs. This section begins with conclusions and recommendations pertinent across all programs (cross-cutting), followed by nonresidential and small business, and ending with residential specific conclusions and recommendations.

1.3.1 Cross-cutting

Conclusion 1: Contractors are key program partners.

Contractors are the driving force of Avista's rebate programs, as they inform both nonresidential and residential consumers about Avista's rebate opportunities and convince them to purchase qualifying equipment. The nonresidential contractors also initiate a notable portion of work in comparison to customer-initiated jobs and appear to be playing a larger role in application preparation than in years past. Both nonresidential and residential customers report being highly satisfied with contractors and are taking into account contractor's recommendations on what to install.

Recommendations: Increase support for contractors.

Consider the following suggestions to continue strengthening relationships with contractors and to improve their effectiveness in generating program savings:

1. Offer an opt-in mailing list to contractors. Contractors subscribed to this mailing list would receive regular information on program offers, changes, trainings, and other program supporting information. This list would be open to any interested contractor.

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2. Promote outreach to contractors: Encourage program staff and account executives to engage further with contractors by continuing and perhaps increasing their involvement with contractor-related resources such as the Northwest Lighting Network. This work can further educate contractors and nudge them to cross-promote the rebate programs to their customers. Additionally, training may help contractors' up-sell high efficiency equipment through the program by improving their understanding of and ability to sell high efficiency solutions. Therefore, Avista should continue to support contractors attending NEEA's training sessions including their recently launched comprehensive training for lighting contractors and distributors.

3. Share effective messaging or marketing collateral with contractors. Contractors could support program and marketing staff by providing insights into how to best target certain customer types, learn from Avista on how to better target certain customer segments, and possibly promote cross-program referrals and participation. As findings from the evaluation show that most contractors specialize in the nonresidential or residential sectors, even if they serve both, developing sector-specific messaging may be particularly effective.

4. Investigate offering cooperative (co-op) marketing. Co-op marketing can help contractors effectively market the program consistent with Avista's objectives and increase customer perceptions of contractor's credibility and cross-promote other programs.

Conclusion 2: Avista and its implementation contractors deliver rebate programs efficiently, and promoting the programs further could help maintain or even increase participation.

Several indicators suggest program promotions could be optimized. First, participants and nonparticipants expressed high interest in learning more about Avista's rebate programs, indicating that although they may be aware of Avista's offers, their knowledge is limited. Second, a majority of residential participants who indicated learning primarily about Avista's offers through contractors were not aware of other program opportunities outside the program they participated in.

Recommendation: Develop more abilities to target marketing. For example, cross-promote programs to recent participants by acknowledging their recent participation and informing them of other program opportunities applicable to their home or business.

Recommendation: For residential customers, continue improving messaging in direct mail promotions to better communicate program information since residential customers prefer to receive this information via mail.

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1.3.2 Nonresidential, Including Small Business

Conclusion 3: Although declining participation rates could threaten Avista's ability to achieve long-term goals, evaluation results point to opportunities to drive additional savings.

Developing new strategies to encourage deeper savings or increased participation will be paramount to reversing the decline in participation and achieving long-term savings goals. Almost one-third of nonparticipants reported they will make a building upgrade in the next two years, indicating a continued potential for program participation. In particular, evidence suggests that much opportunity remains for converting lighting from T12s.

Recommendation: Develop a marketing approach specifically targeting replacement of T12 lamps.

The switch to a T8 baseline in 2012 had a dramatic effect on participation because the rebates became far less attractive to customers to upgrade from T12s.[1] While it may not be feasible for Avista to alter the baseline for T12 change-outs, Avista should look into developing targeted marketing strategies for convincing nonresidential customers with T12s to replace them with more efficient lighting, focusing not only on savings but improved lighting quality and performance. Avista could begin by targeting businesses that the Small Business Program has identified as still having T12s.

Recommendation: Work with nonresidential lighting contractors to promote replacement of T12 lamps.

Contractors make their living by selling equipment. Avista should work with nonresidential lighting contractors to make sure they are fully aware of the advantages that more efficient lighting (including the reduced wattage tube lighting that NEEA is targeting through its Reduced Wattage Lamp Replacement Initiative) offers their customers.

Recommendation: Consider claiming Simple Steps savings for bulbs purchased for the nonresidential sector.

The evaluation found that about 12% of Simple Steps LED sales and somewhere from 5% to 12% of Simple Steps CFL sales go to nonresidential customers. The mean hours of use for such lighting is much higher in a nonresidential than residential settings, meaning that the total Simple Steps savings is potentially higher than currently estimated, and at a minimum, Avista should consider claiming the additional savings for these purchases.

1.3.3 Residential

Conclusion 4: Participation in the Avista rebate programs has rebounded since 2013 driven by a fivefold increase in shell program participation.

[1] A very similar thing happened to another program administrator in Missouri. See Ameren Missouri BizSavers Process Evaluation Report 2015.

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Rebate program participation reached a low point in 2013, after which participation increased year over year by 51% from 2013 to 2014 and by 43% from 2014 to 2015. This is a positive sign; however, maintaining or increasing program participation requires cost effective savings opportunities for residential customers. Avista's residential programs operate in a fast-changing market. Consumers are adopting LEDs rapidly, [2] retailers are transitioning away from CFLs to LEDs,[3] and the federal government and regulators are mandating higher efficiency standards for bulbs and other energy efficient technologies.[4] The convergence of these forces has implications for the cost effectiveness of Avista's downstream rebate programs. Program administrators throughout the United States are exploring and testing alternative program designs such as upstream and midstream designs in response to the evolving market. Although Avista is currently participating in the Simple Steps, Smart Savings program (a midstream program), when asked about future opportunities, program staff did not mention any upcoming pilots or programs that apply these types of designs.

Recommendation: Continue regularly reviewing the expected savings and cost-effectiveness of the measures in residential portfolio and exploring the benefits and costs of other program designs including upstream and/or midstream designs. Consider these suggestions:

1. Continue monitoring the technological advances and availability of ductless heat pumps and water heating equipment. Surveyed contractors recommended both of these categories as candidates for inclusion in Avista's programs. NEEA, for example, has been working to promote the savings potential of heat pump water heaters in the Northwest via the Northern Climate Heat Pump Water Heater Specification,[5] and The Northwest Power and Conservation Council has identified both of these measure types as promising technologies in the recently adopted Seventh Power Plan.[6]

2. Explore upstream program opportunities outside of the lighting market. Upstream incentive programs offer the potential to increase the adoption of energy efficient technologies at a lower cost compared to downstream incentive programs. Program administrators in California and elsewhere have successfully tested or used upstream

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[2] 1 of 20 A-line bulbs sold nationally was an LED in third quarter of 2014, whereas in the quarter prior to that, it was 1 in 30. This statistic comes from the *2015 LED Market Intelligence* report by Bonneville Power Administration. https://www.bpa.gov/ee/utility/research-archive/documents/momentum-savings-resources/led_market_intelligence_report.pdf

[3] Souza, Kim, 2016. *Walmart to transition lighting products away from compact fluorescent to LED.* Retrieved from http://talkbusiness.net/2016/02/walmart-to-transition-lighting-products-away-from-compact-fluorescent-to-led/

[4] The lighting standard, established by the Energy Independence and Security Act of 2007, requires that light bulbs use about 25% less energy by 2014. New efficiency heating and cooling standards from the U.S. Department of Energy, which have gone into effect Jan. 1, 2015, will increase the efficiency of heating, ventilation, and air-conditioning (HVAC) equipment in certain regions.

[5] http://neea.org/northernclimatespec/

[6] http://www.nwcouncil.org/energy/powerplan/7/plan/

program designs for technologies that Avista currently incents, including HVAC equipment and water heaters.[7]

Conclusion 5: Residential customers who rent their home are underserved. Nonparticipants say living in a rental property prohibits them from making improvements. This was the second most commonly cited barrier to making energy efficient upgrades among nonparticipants (after the up-front cost barrier). More than a quarter (27%) of nonparticipant survey respondents were renters, whereas only 3% of the participant survey respondents were renters. Renters account for about one-third of the population in Avista territory.[8]

Currently, Avista serves renters via the low-income program. The CAP agencies reported having difficulty serving the low-income renter population because it is difficult to convince landlords to participate. Additionally, there appears to be no multifamily program in the Avista portfolio that could serve this market, although Avista does offer an incentive for a natural gas space and water heating measures to multifamily property owners.

Recommendation: Investigate energy savings opportunities in the rental market. Consider the following suggestions:

1. Estimate the number and distribution of rental units in the single family, manufactured home, and among multifamily buildings. Analyzing these data geographically and by vintage would likely yield insights regarding the energy saving potential in these markets.

2. Conduct needs assessment research with landlords to understand their needs and concerns and explore ways to bolster their willingness to make energy efficiency upgrades on their properties. This research should consider the needs landlords serving low-income renters as well as renters not eligible for the low income program.

3. Conduct needs assessment research with renters to understand their needs and the barriers to participation they face. For example, although some energy savings activities may not be appropriate for renters (for example, HVAC system replacement), other activities such as installing energy efficient lighting and/or advanced power strips could be appropriate.

[7] Quaid, M. and H. Geller (2014). *Upstream Incentive Utility Programs: Experience and Lessons Learned.* Retrieved April 14, 2016. http://www.swenergy.org.

[8] US Census Bureau. "B25003 : Tenure." 2010 – 2014 American Community Survey 5-Year Estimates. Web. 13 April 2016.

2 Introduction

2.1 Purpose of Evaluation

The purpose of the process evaluation was to identify any improvements needed at the portfolio level to increase program effectiveness, efficiency, and identify opportunities for future programs. The process evaluation collected interview and survey data from program staff, implementation contractors, program participants, nonparticipants, contractors, and retailers. Additionally, the evaluation examined program participation data and Opower data.

Table 2-1 summarizes the primary objectives and specific areas for investigation along with the information sources the evaluation team used to investigate them.

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Table 2-1: Process Evaluation Objectives and Information Sources

Objective	Program Document Review**	Staff interviews	Implementation Contractor Interviews	Participating Customer Survey	Participating Contractor Survey	Nonpartic-ipating Customer Survey	Retailers
Appropriateness of design, participation procedures, internal communication, rebate processing activities (e.g., ease of use, cycle time)		✓	✓	✓	✓	✓	
Participant satisfaction with programs	✓	*	*	✓	✓		
Barriers to participation, effectiveness of incentives in motivating action		*	*	✓	✓	✓	
Effectiveness of marketing and promotional efforts; status of marketing research activities	✓	✓	✓	✓	✓	✓	
Opportunities for process improvement and potential programs; status of Avista response to previous evaluation recommendations	✓	✓	✓	✓	✓	*	
Obtain data for net-to-gross analysis***				✓	✓	✓	
Understand declining participation rates of programs	✓						
Identify commercial uptake of Simple Steps items				✓		✓	✓
Understand the importance of savings associated with rebated measures and the Home Energy Reports	✓						
Review and update program logic models	✓	✓					

*Supporting information; ** Descriptions; procedures; design docs; application forms; participant records; marketing materials; etc.; *** Net-to-gross results appear in impact report

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2.2 Description of Nonresidential Programs

Avista provided incentives and services for its nonresidential electric and gas customers throughout its Washington service territory and nonresidential electric customers in its Idaho service territory in 2014 and 2015.

Avista uses financial incentives and direct installation of efficient measures to encourage its commercial and industrial customers to install energy efficiency equipment. The evaluation team examined three core programs that constitute the bulk of Avista's nonresidential energy efficiency offerings in 2014 and 2015: the Prescriptive, Site Specific, and Energy Smart Grocer programs. In addition, the evaluation team examined Avista's new Small Business program which began in June 2015. Table 2-2 provides a summary of those programs and the sections below provide greater details about each program.

Table 2-2: Key Energy Efficiency Programs

Program	Implementer	Summary
Prescriptive	Avista	Contractors and account managers work with nonresidential customers to identify potential projects, submit paperwork, and process incentive applications.
Site Specific	Avista	Contractors, account managers, and program engineers' work with nonresidential customers to identify potential projects, submit paperwork, and verify project savings in order to process incentives.
Energy Smart Grocer	CLEAResult	Implementer staff conduct outreach to customers with refrigeration equipment (primarily grocery stores) and conduct an energy audit that identifies energy saving projects. If the customer elects to conduct the project(s), implementer staff work with the customer and contractors to install equipment.
Small Business	SBW	Implementer staff provide small business customer's (rate schedule 11) brief property assessments and energy efficiency measures such as LED lighting and faucet aerators.

2.2.1 Prescriptive

Avista's prescriptive program provides incentives and services for the following types of electric- and gas-using equipment.

- Food service equipment
- Commercial clothes washers
- Commercial water heaters
- Lighting
- HVAC
- Building shell (Windows and Insulation)
- Multifamily development
- Motors
- Variable Frequency Drives
- Compressed air leak detectors
- Power management for PC networks

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These incentives and services are available to customers who purchase eligible equipment, submit a completed application within 90 days after installation, and provide proof of purchase for all relevant equipment and labor. Customers typically receive their reimbursement about four to six weeks after Avista receives a complete application. Avista reserves the right to inspect the installation before processing the rebate.

2.2.2 Site Specific

Avista provides Site Specific services that include helping customers identify energy saving opportunities and take action to implement those opportunities. Site specific projects may or may not include prescriptive measures but will always include measures specific to a facility. For example, a Site Specific project may include custom controls with prescriptive lighting installed at a given site Eligible measures must have a simple payback less than 15 years and qualify for $.20 per first year kWh saved for electricity and $3 per first year therm saved. Incentives are capped at 70% of the incremental project cost.

2.2.3 Energy Smart Grocer

Grocers, convenience stores, restaurants, and any customers with commercial refrigeration are eligible to participate in the Energy Smart Grocer program. The program, implemented by CLEAResult, provides no-cost assessments of eligible facilities that result in recommendations for prescriptive measures the customer could implement to save energy. Measures include case lighting, controls, refrigerated case gaskets, and motors. Similar to the prescriptive program, the customer must submit an application after the installation and usually wait four to six weeks before receiving their incentive. The customer may opt to release the incentive directly to the installation contractor.

2.2.4 Small Business Program

The Small Business (SB) program is a third-party-administered program that provides customer's energy efficiency opportunities by conducting the following activities.

1. Conduct a brief onsite audit to identify customer opportunities and interest in existing Avista programs,
2. Install appropriate energy-saving measures at each target site, and
3. Provide materials and contact information so that customers are able to follow up with additional energy efficiency measures under existing programs.

Direct-install measures include: faucet aerators, showerheads, pre-rinse spray valves, screw-in LED's, smart strips, CoolerMisers, and VendingMisers. In 2015 the SB program was only available to customers who receive electric service under Rate Schedule 11 in Washington and natural gas service under Rate Schedule 101 in Washington. The program intends to add Schedule 11 Idaho customers in 2016. They did not target Idaho in 2015 because they were waiting to see if Idaho would allow gas saving measures. Schedule 11 customers typically use less than 250,000 kWh per year. The smaller size and the relatively large number of schedule

11/101 customers makes them a notoriously difficult to reach and underserved market segment. SBW Consulting, Inc., based in Bellevue, WA, started program operations in June 2015 and is under contract to deliver the program through May 2017.

2.3 Description of Residential Programs

Avista provided incentives and services for its residential electric and gas customers throughout its Washington service territory and for residential electric customers throughout their Idaho service territory in 2014 and 2015.

Avista uses financial rebates or discounts, reports on energy usage, and direct installation of efficient measures to encourage its residential customers to install energy efficiency equipment. The evaluation team examined eight core programs that constitute the bulk of Avista's residential energy efficiency offerings in 2014 and 2015.Table 2-3 provides a summary of those programs and the sections below provider greater details about each program.

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Table 2-3: Residential Program Type and Description

Type	Programs	Implementer	Description
Rebate	Appliance Recycling	JACO	Rebate for recycling fridge or freezer older than 1995. This program was discontinued in June 2015.
	ENERGY STAR® Homes	Avista	Rebate for purchase of ENERGY STAR® home
	Fuel Efficiency	Avista	Rebate for conversion of electric to natural gas furnace and/or water heater
	HVAC Program	Avista	Rebate for purchase of energy efficient and high efficiency HVAC equipment, including variable speed motors, air source heat pump, natural gas furnace and boiler, and smart thermostat
	Shell	Avista	Rebate for adding insulation to attic, walls, and floor, as well as adding energy efficient windows. Rebate for duct sealing, program measure discontinued at end of 2014.
	Water Heater	Avista	Rebate for installation of high efficiency gas or electric water heater, natural gas water heater, and Smart Savings showerhead
Midstream	Simple Steps, Smart Savings	CLEAResult	Direct manufacture discount for purchase of approved CFLs, LEDs (bulbs and fixtures), and low-flow showerheads.
Behavior	Home Energy Reports	Opower	The Opower program generates behavioral savings from a treatment group, which receives Home Energy Reports, which compares the customer's energy usage to similar homes in Avista's service territory.
Low-income	Low-income Programs	Community Action Partners (CAPs)	CAPs within Avista's Washington and Idaho service territories implement the projects. CAPs determine energy-efficiency measure installations based on the results of a home energy audit.

2.3.1 Appliance Recycling

The appliance recycling program ceased operation in June 2015 because it was deemed cost ineffective. Prior to that, the program provided customers a $40 rebate for recycling a refrigerator manufactured before 1995.

2.3.2 ENERGY STAR® Homes

New home buyers can apply for an $800 rebate for an ENERGY STAR® ECO-rated new manufactured home or $1,000 for an ENERGY STAR® stick-built home. The purchaser must submit the application and certification paperwork to Avista within 90 days of occupying the residence.

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2.3.3 Fuel Efficiency

Customers interested in switching from electrically fueled heating and water heating equipment to gas fueled equipment are eligible for flat-rate rebates.

2.3.4 Heating, Ventilation, and Air Conditioning (HVAC) Rebates

Avista offers prescriptive rebates for heating equipment such as efficient furnaces or boilers and variable speed motors, and smart thermostats.

2.3.5 Water Heat Rebates

Avista offers prescriptive rebates for electric and gas efficient water heaters and water saving fixtures.

2.3.6 Shell Measures

The Shell program provides prescriptive rebates for shell measures like insulation (attic, wall, and floor), windows, and duct sealing. Contractors generate most of the participants in this program, except for duct sealing participants. Duct sealing is primarily implemented by UCONs, a third party contractor. UCONs offers duct sealing to customers free of charge and is responsible for duct sealing and installation of any other direct install measure that might be part of the agreement with Avista. UCONs duct sealing program ceased operating in 2015.

2.3.7 Simple Steps, Smart Savings

The Simple Steps, Smart Savings program provides discounts to manufacturers to lower the price of efficient light bulbs, light fixtures, showerheads, and appliances. This program, administered by CLEAResult, operates across the Pacific Northwest and utilities are able to select which items they want the price lowered. Avista chose general and special CFLs, LED light fixtures, LED bulbs,[9] and showerheads.

2.3.8 Home Energy Reports

Avista and Opower provide free Home Energy Reports (HERs) to a sample of customers that compares their energy usage to that of similar homes in their area. Using behavioral science, the program encourages customers to save energy and offers those that receive HERs with insights into how they can lower energy use.

2.3.9 Low-Income

Local CAP agencies within Avista's Washington and Idaho service territory implement projects with qualifying low income customers. CAPs assess homes for energy-efficiency measure applicability, combining funding from Avista and state/federal programs to apply appropriate measures to a home, based on the results of a home energy audit. CAPs typically approve the installation of the following measures: shell upgrades (insulation, air-sealing, etc.), duct sealing,

[9] Avista offered LED bulbs in 2014 and the last half of 2015.

refrigerator replacements, fuel conversions, low-cost measures (window plastic or lighting measures), and health and safety measures.

3 Methods

To conduct a process evaluation of Avista's energy efficiency programs, the evaluation team reviewed program data and completed 23 interviews and 902 surveys with market actors. Table 3-1 provides an overview of the data collection activities, including the type of data collection effort and the key topics covered. All interview and survey guides are provided in Appendix C.

Table 3-1: Overview of Data Collection Activities

Data Source (Sample by sector)	Type[a]	When	Analytic Techniques	Key Topics
Staff (16; 4 nonres. and 12 res.)	Interview	Feb. 2015, & Oct. 2015	Qualitative, thematic	▪ Program goals ▪ Program processes ▪ Communication and coordination ▪ Data tracking ▪ Future program opportunities ▪ Outreach
Implementers (7; 1 nonres. and 6 res.)	Interview	Oct. 2015	Qualitative, thematic	
Contractors (82; 29 nonres. and 53 res.)	Survey	Aug. 2015, Oct. 2015	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Satisfaction ▪ Motivations to participate ▪ EE Sales practices ▪ Net-to-Gross
Participants (680; 305 nonres. and 339 res.)	Survey	May 2015 – Feb. 2016	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Satisfaction ▪ Program experience ▪ Freeridership & spillover ▪ Leakage of Simple Steps products into commercial sector
Nonparticipants (140; 70 nonres. and 70 res.)	Survey	Oct. – Nov. 2015	Quantitative, univariate and bivariate frequencies	▪ Program awareness ▪ Experience with EE ▪ Leakage of Simple Steps products into commercial sector ▪ Spillover
Staff and implementer manager (2)	Interview	Dec. 2015	Qualitative, thematic	▪ Program goals ▪ Program requirements ▪ Communication and coordination ▪ Marketing ▪ Implementation
Installers (2)	Interview	Dec. 2015	Qualitative, thematic	▪ Staff background ▪ Role in outreach ▪ Data collection and reporting ▪ Challenges and barriers to participation ▪ Implementation successes
Participants (31)	Survey	Jan. - Feb. 2016	Quantitative, univariate and bivariate frequencies	▪ Program experience ▪ Satisfaction ▪ Future EE plans ▪ Business characteristics

[a] The Nexant survey call center fielded the surveys and Research Into Action staff conducted in-depth interviews.

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The sections below provide a brief overview of the sample and methods used to analyze each data source. The evaluation team first provides an overview where data collection methods were the same for both the nonresidential and residential sectors (cross-cutting) followed by nonresidential, residential and special study specific methods.

3.1 Cross-cutting activities

3.1.1 Staff and Implementer Interview Methods

The evaluation team carried out two sets of staff interviews pertaining to the nonresidential and residential portfolios. One, conducted in February 2015, took place in a group setting and included program, engineering, and planning staff. This set of interviews helped the evaluation team better understand the residential and nonresidential programs and provided an opportunity for Avista staff to share questions they had for the evaluation. The evaluation team recorded each group interview, with the interviewees' permission. These interviews typically lasted 90 minutes.

The second set of interviews, conducted in September and October 2015, focused on key Avista staff responsible for nonresidential programs (prescriptive lighting, prescriptive non-lighting, and Site specific), residential programs (rebate programs, Opower HERs, Simple Steps, Smart Savings, and Low-income) marketing, and data management. Additionally, the evaluation team interviewed key implementers including a staff person representing the Energy Smart Grocer program, three implementers representing residential programs, and four Community Action agencies representing implementation staff of Avista's low income programs. Each interview lasted 45 to 60 minutes. Interviews covered topics such as roles and responsibilities, program goals, communication among staff and implementers, program processes, marketing, program changes, and future program opportunities. The evaluation team integrated results from these interviews into the findings sections of this report.

In addition to the staff and implementer interviews conducted as part of the nonresidential and residential portfolios, the team interviewed all staff and installers for the Small Business program. These interviews took place in December 2015 and lasted about 45 to 60 minutes. Interviews covered topics such as goals, future program plans, program implementation, marketing, and key successes and challenges. Results of these interviews are discussed in section 5.3.

3.1.2 Contractor Sample

The evaluation team elected to focus on high-impact contractors – those involved with projects that delivered the most savings in program year 2014 and 2015. In the nonresidential sector that meant interviewing lighting and HVAC contractors. In the residential sector that meant interviewing HVAC and building shell contractors.

Using data assembled by Avista staff, the evaluation team identified 658 unique contractors operating in Avista territory. The evaluation team categorized these contractors as lighting (400), HVAC (89), and Shell (55) contractors. The evaluation team could not classify the

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remaining 114 contractors without additional information. Therefore, the evaluation team based the initial sample on the 544 categorized records.

About three-quarters of the way through completing surveys, the evaluation team determined additional sample was necessary to complete HVAC and lighting contractor surveys, particularly in the nonresidential sector. The evaluation team added 75 additional lighting contractors and 14 uncategorized records to the survey sample. Through additional research, we were able to identify these 14 records as likely HVAC contractors (Table 3-2).

Table 3-2: Contractor Population and Sample

	Initial Population	Initial Sample	Additional Sample	Total Sample
HVAC	89	89	14	103
Lighting	400	54	75	129
Shell	55	55	-	55
Uncategorized	114	-	-	-
Total	658	198	89	287

While some contractors likely worked in both the residential and nonresidential sectors, to lower the survey burden, the evaluation team surveyed each contractor about work done in only one of those sectors. The information available in program records did not identify whether a contractor worked primarily in the residential or nonresidential sector. To identify the primary sector served, the survey first asked contractors what percentage of their projects are in each sector. Those who reported completing 50% or more of their projects in the nonresidential sector answered questions about work done in the nonresidential sector and the rest answered questions about work done in the residential sector. A large majority (82%) of the respondents reported doing at least 70% of their work in one sector or the other, indicating a reasonably clear distinction between nonresidential and residential contractors.

As Table 3-3 shows, the evaluation team exceeded the total goal by six interviews. Because fewer contractors specialized in nonresidential work than expected, the evaluation team achieved fewer than the target number of survey completions for that sector.

Table 3-3: Contractor Survey Target and Completions

	Target			Completions		
	Residential	Nonres.	Total	Residential	Nonres.	Total
HVAC	19	19	38	35	8	43
Lighting	-	19	19	-	21	21
Shell	19	-	19	18	-	18
Total	38	38	76	53	29	82

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If the distribution of mainly nonresidential and mainly residential contractors is the same in the population as in the survey, then there are about 202 mainly nonresidential contractors and 376 mainly residential contractors in Avista's territory.[10] The 29 nonresidential completions provides 90/14 confidence and precision and the 53 residential completions provides 90/10 confidence and precision in the findings.

The evaluation team interviewed all contractors about the following topics:

- Awareness of Avista energy efficiency programs
- Motivations to participate in programs
- Satisfaction with programs
- Sales practices related to energy efficient equipment

The evaluation team carried out the contractor telephone survey in August and October 2015. The evaluation team analyzed the close-ended data using SPSS and used MS Excel to code all open-ended responses.

3.2 Nonresidential Activities

Nonresidential data collection activities included surveys with participants and nonparticipants. The evaluation team describes each activity below.

3.2.1 Participant Survey Sample and Methods

The participant surveys covered the following process evaluation related topics:

- Awareness of Avista programs and incentives
- Awareness of energy efficient equipment
- Satisfaction with staff interactions, equipment, clarity of information, time needed to participate, and, if relevant, their audit experience.
- Energy efficient policies and practices

The evaluation team administered the survey in phases to provide Avista staff with up-to-date market feedback throughout the evaluation period. The first participant survey occurred in July 2015, capturing data from 2014 and Q1 and Q2 2015 participants. The next survey, conducted in October 2015, captured data from Q3 2015 participants and the last participant survey occurred in January 2016, capturing data from Q4 2015 participants. The evaluation team analyzed all survey data using SPSS and used MS Excel to code all open-end responses. The evaluation team examined responses for differences by state (Washington or Idaho) and year of

[10] The evaluation team assumed the proportion of the sample that is commercially focused, 35%, represents the population than there are 202 commercially focused contractors (.35*578 =202) and 376 (.65*578) residentially focused contractors.

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participation (2014 or 2015). The final tally of survey completions provides for 95/5 confidence and precision at the portfolio level.

The evaluation team developed a stratified random sample of participating Avista customers by program and state that included both electric and gas customers. The evaluation team estimated the target completions using assumptions about participation as of January 2015. Actual participation varied from the estimates, resulting in fewer survey completions needed in some program types and more for other program types. Table 3-4 summarizes the targeted and actual number of completions by year, and Table 3-5 shows the distribution of the sample population and survey completes by program.

Table 3-4: Nonresidential Participant Survey Completions by Program Type and Fuel

Program type	Target Survey Completions			Actual Survey Completions		
	2014	2015	Total 2014-2015	2014	2015	Total 2014-2015
Washington/Idaho Electric						
Prescriptive Lighting	32	36	68	40	42	82
Prescriptive Energy Smart Grocer	20	24	44	22	13	35
Prescriptive Non-Lighting Other	12	12	24	14	14	28
Cascade Energy Pilot	-	4	4	-	-	-
Site Specific	40	44	84	46	39	85
Washington Gas						
Prescriptive (Appliance)	5	6	11	1	-	1
Prescriptive (Shell)	12	12	24	15	7	22
HVAC	12	12	24	9	12	21
Food Service	5	6	11	2	8	10
Site Specific	20	23	43	5	16	21
TOTAL	158	180	338	154	151	305

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Table 3-5: Population and Completed Sample Distribution by Program

Program name	2014		2015	
	Sample Population*	Survey Completions	Sample Population*	Survey Complete
Food Service	53	12	25	13
HVAC	44	9	83	19
Prescriptive Lighting	180	40	235	42
Water Heat	3	2	1	-
Windows and Insulation	42	16	10	9
Energy Smart Grocer	57	22	20	13
Green Motors	10	2	-	-
Site Specific	101	51	108	55
Standby Generator Block Heater	6	-	-	-
TOTAL	**496**	**154**	**482**	**151**

* Indicates number of participants in which we were able to draw a sample.

3.2.2 Nonparticipant Survey Sample and Methods

The nonparticipant survey covered the following topics related to the process evaluation:

- Awareness of Avista programs
- Recent history of using energy efficient equipment
- Planned upgrades that will use energy efficient equipment
- Energy efficient policies and practices
- Interest in energy efficiency programs

According to data received from Avista, there were 43,848 unique nonparticipant commercial accounts throughout Avista's Washington and Idaho territory in 2015. The evaluation team identified 23,180 unique telephone numbers within the population of accounts, and used that number as a proxy for the size of the population of nonparticipant contacts. To ensure that the survey correctly represented the high- and low-density areas of Washington and Idaho, the evaluation team stratified the random sample on state as well as on population density.[11] The distribution of completed interviews across the four strata closely matched the distribution of the population across the strata (Table 3-6), and the 70 completes provide for 90/10 confidence and precision.

[11] The mean population density is 588 people per zip code. The low-density strata included zip codes with population densities below the mean (588) for all zip codes in Avista territory, and high-density strata included zip codes with population densities greater than or equal to the mean for all zip codes in Avista territory.

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Table 3-6: Nonparticipant Nonresidential Population and Survey Completes

	Nonparticipant Population of Unique Contacts		Survey Completes	
	Count	Percent	Count	Percent
Low Population Density - ID	8,741	38%	25	36%
Low Population Density - WA	6,231	27%	18	26%
High Population Density - ID	772	3%	3	4%
High Population Density - WA	7,436	32%	24	34%
TOTAL	**23,180**	**100%**	**70**	**100%**

The evaluation team administered the survey in October and November 2015 and analyzed the data using SPSS for close-ended data and MS Excel to code all open-ended responses. The evaluation team examined responses for differences by state (Washington or Idaho) and year of participation (2014 or 2015).

3.2.3 Small Business Process Evaluation Methods

The primary goal of the Small Business (SB) process evaluation was to assess and provide information on program delivery and implementation and market response to the program. The evaluation focused on program design and theory, implementation and delivery, and market feedback.

The evaluation team evaluated the programs through interviews with pertinent program actors including Avista and third-party implementation staff, auditors/installers, and participants (Table 3-7). Avista engaged the evaluation team to evaluate the SB program after the evaluation of the rest of the program portfolio had begun, and under a separate contract. Therefore, the evaluation team conducted specific staff and implementer interviews for the SB program, separately from other staff and implementer interviews. The SB-specific interviews are described in this section rather than in Section 3.1.1, above, as they are not cross-cutting.

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Table 3-7: Overview of Small Business Data Collection Activities

Source (Sample)	Type	When	Analytic Techniques	Key Topics
Staff and implementer manager (2)	Interview	Dec. 2015	Qualitative, thematic	▪ Program goals ▪ Program requirements ▪ Communication and coordination ▪ Marketing ▪ Implementation
Installers (2)	Interview	Dec. 2015	Qualitative, thematic	▪ Staff background ▪ Role in outreach ▪ Data collection and reporting ▪ Challenges and barriers to participation ▪ Implementation successes
Participants (34)	Survey	Jan. - Feb. 2016	Quantitative, univariate and bivariate frequencies	▪ Program experience ▪ Satisfaction ▪ Future EE plans ▪ Business characteristics

Of the 1,181 SB participants in the program database, 35 had received audits but did not have any measures installed, leaving 1,146 with measures. Of those, 344 had phone numbers. The distribution of those with phone numbers did not differ noticeably from the population in terms of measures received or location; therefore, the evaluation team concluded that sampling from those with phone numbers would not bias the sample in terms of those key variables. Assuming a response rate of about 15%, the evaluation team selected a random sample of 200 from the list of 344 participants with phone numbers.

The evaluation team randomized the sample and called businesses in the random order. To ensure that the completed survey covered all the areas in which the program was active, the evaluation team set quotas by location (North Washington, South Washington, and Spokane) to ensure that distribution of survey completions across the three areas would be similar to the distribution of the participant population across those areas.

The evaluation team exceeded its assumed response rate, achieving a 32% response rate, and was able to complete the survey after calling the first 105 businesses in the sample. Table 3-8 shows the disposition of the entire sample.

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Table 3-8: Disposition Summary

	Count	Percent of Sample Attempted
Complete	34	32%
Refusal	6	6%
Not reached	63	60%
Left job	1	1%
Bad number	1	1%
Sampled businesses called	105	100%
Sample businesses not called	95	-
TOTAL	**200**	-

The completed sample closely matched the participant population on the three locations in which the program was active (Table 3-9). As the table shows, the sample also included a greater percentage of lighting, water-saving, and non-lighting power-saving measures than the participant population.[12]

Table 3-9: Distribution of Population, Sample, and Completed Sample

	Population (*n* = 1,013)		Sample (*n* = 200)		Complete (*n* = 34)	
	Count	Percent	Count	Percent	Count	Percent
Location						
North Washington	156	15%	17	9%	7	20%
South Washington	160	16%	28	14%	6	17%
Spokane	697	69%	155	78%	21	62%
Measure Type						
Any lighting	303	30%	76	38%	15	44%
Any water saving	949	94%	193	97%	34	100%
Any non-lighting, power-saving	320	32%	71	36%	18	53%

The completed sample achieved at least 14% precision at 90% confidence.

3.3 Residential Activities

Residential data collection activities included surveys with participants and nonparticipants. The participant and nonparticipant surveys covered the following process evaluation related topics:

- Awareness of Avista programs and rebates

[12] This is because it had a higher percentage of participants with multiple measures than did the population.

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- Motivations and barriers to participation
- Program experience, if participants
- Attitudes toward Energy Use and Conservation
- Purchases of energy efficient products

The evaluation team received 2014 and 2015 residential customer account data from Avista that identified rebate and appliance recycling participants and all other residential customers (nonparticipants). The data contained: 1) measures installed/recycled and the rebate received for program participants; 2) geographic location (ID or WA); 3) utility services (gas, electric, or both); and 4) contact information.[13] The 2014 and 2015 data included approximately 480,000 residential customers, containing a total of 7,505 participants in 2014 and 11,620 participants in 2015.

To facilitate the evaluation team's evaluation of the residential lighting program, Simple Steps, Smart Savings, and the residential behavior program administered by Opower, the evaluation team included survey questions asking respondents whether they purchased discounted products from participating retailers or received Home Energy Reports or HERs to identify possible participants in these two programs.

The evaluation team developed a stratified random sample of rebate/appliance recycling participants and nonparticipants. The evaluation team stratified the participant sample by year of participation (2014 or 2015) and state (WA or ID). Nonparticipant sample was stratified by state (WA or ID) and urban area (whether living in urban or rural zip codes). Both samples included electric and gas Avista customers. Table 3-10 summarizes the number of participant and nonparticipant completes by state and year.

Table 3-10: Sample Distribution for Residential Program Participants and Nonparticipants

State	2014 Participants		2015 Participants		Nonparticipants	
	Population	Sample	Population	Sample *	Total	Sample
ID	1,143	29	1,823	59	160,455	23
WA	6,362	124	9,797	127	319,370	47
TOTAL	**7,505**	**153**	**11,620**	**186**	**479,825**	**70**

* 67 interviewed in Quarter 1 (Q1) of 2015, 53 interviewed in Q2, 46 interviewed in Q3, and 20 interviewed in Q4 of 2015.

The evaluation team also monitored the status of the participant survey to ensure the relevant programs and measures were represented in the survey responses. The evaluation team exceeded the target samples for all programs except the WA gas water heat and ENERGY STAR Homes programs (Table 3-11).

[13] The evaluation team received contact information for the sample only.

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Table 3-11: Residential Participant Surveys

Residential Program	Target Completes			Actual Completes		
	2014	2015	Total	2014	2015	Total
Washington/Idaho Electric						
Appliance Recycling	34	36	70	35	37	72
HVAC	32	36	68	32	36	68
Water Heat	5	8	13	5	8	13
ENERGY STAR Homes	7	8	15	11	5	16
Fuel Efficiency	5	20	25	5	20	25
Shell	12	12	24	13	15	28
Washington Gas						
Water Heat	5	8	13	5	6	11
ENERGY STAR Homes	5	8	13	1	10	11
HVAC	22	24	46	24	24	48
SHELL	22	24	46	22	25	47
TOTAL	**149**	**184**	**333**	**153**	**186**	**339**

3.4 Special Studies Activities

The evaluation team conducted several special studies as part of the evaluation. This section provides a brief description of the methods used for each activity. Details about the methods used for the declining participation rates and participation rates among Opower participants are provided in sections 7.1 and 7.2.

3.4.1 Declining Participation Rates

The 2012-2013 process evaluation report[14] noted that program participation rates based on the number of rebated measures have declined since 2010. The 2012-2013 process evaluation report also suggested that one explanation for the decline in participation was fewer measures offered through the programs and the reduced incentive amounts that Avista offered in response to declining avoided costs. The evaluation team examined the list of rebated measures in both nonresidential and residential 2010-2015 program databases to assess the potential impact of the fewer rebated measures and the reduced incentive amounts on participation.

[14] Avista 2012-2013 Process Evaluation Report, May 15, 2014, Cadmus.

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3.4.2 Participation Rates Among Opower Behavioral Program Participants and Nonparticipants

Understanding the importance of savings associated with rebated measures and the Opower Behavioral Program (Home Energy Reports (HER) program) will enable Avista to better understand the extent of induced behavioral savings not attributed to rebated measures and the rebated measure portion of the savings. The evaluation team used residential customer data and program participant's data to conduct this analysis.

3.4.3 Commercial Uptake of Simple Steps Measures Methods

The evaluation team used two methods to estimate the proportion of the CFL and LED markdown measures (Simple Steps measures) going to the residential and nonresidential sectors, respectively. Both methods relied on data collected from the process evaluation. The first approach relied on data from the nonresidential participant and nonparticipant surveys. The second approach relied on a survey of store and department managers at the dominant retailers of Simple Steps items. These following subsections describe these approaches.

3.4.3.1 Nonresidential Customer Surveys

The nonresidential participant (n=305) and nonparticipant surveys (n=70) asked respondents to estimate the number of light bulbs they purchased for their businesses and if they recalled seeing Simple Steps marketing materials near or on their(See section 3.2 for discussions of the sample frame preparation for participants and nonparticipants). The evaluation team analyzed responses using SPSS and Microsoft Excel®. The evaluation team summed the number of CFL and LED items attributable to Simple Steps separately for participants and nonparticipants.

3.4.3.2 Retail Store Manager Survey

The survey of retail store managers asked respondents to estimate the proportion of sales of Simple Steps measures that went to residential and nonresidential customers. In a previous, similar project, members of the evaluation team determined that the only types of respondents who were able to answer such questions were those from large chain stores like The Home Depot, Costco, and Walmart, which have staff devoted to selling lighting products and/or sell large quantities of incented items.

A review of the Simple Steps sales data in Avista territory showed that those same three retailers accounted for about 90% of sales (Table 3-12); the sample frame thus included the 28 participating stores from those three retailers. It also included the four participating Lowes stores; this chain is similar to the three dominant retailers and sold, on average, many times more units per store than retailers other than Walmart, Costco, and Home Depot. In sum, the sample frame consisted of 32 stores from one of these four retailers.

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Table 3-12: Retailer Sales Data in Simple Steps

Retailer	Number of Stores	Total Units Sold	% Of All Units Sold	Mean Units Sold per Store	Included in Sample Frame
Walmart	16	421,376	35%	26,336	Yes
Costco	5	394,185	33%	78,837	Yes
Home Depot	7	266,434	22%	38,062	Yes
Lowes	4	24,046	2%	6,012	Yes
All other stores	102	96,435	8%	945	No
TOTAL	**134**	**1,202,476**	**100%**	**8,974**	**N/A**

The evaluation team surveyed representatives from 27 of the 32 stores and reached all four retailers in January 2016. Surveys took approximately five to 10 minutes to complete. The evaluation team analyzed responses using SPSS and Microsoft Excel®.

3.5 Review of Program Logic Models

The evaluation team updated the existing logic models for the residential and nonresidential programs after speaking with program staff and implementers. Each updated logic model is located in the Appendix B.

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4 Nonresidential Process Results

The sections below provide the results of the nonresidential process evaluation of Avista's nonresidential programs. This section begins with an overview of the administration activities of the programs and a summary of challenges staff reported facing with administration of programs. Subsequent sections discuss program awareness, the company culture of market actors, the experience of market actors within the program, and concludes with possible opportunities to increase program participation.

4.1 Program Administration

The evaluation team interviewed the leaders of each nonresidential program covered in this evaluation. The following section describes the key points noted by staff regarding the administration of the program and possible program changes.

Nonresidential program staff and implementers did not report any systemic problems or issues of concern in program implementation. During the mid-year interviews, they all stated that data tracking and reporting was adequate for their needs and all reported smooth internal communications with one another.

Staff noted that Avista changed customer databases between 2014 and 2015 which did cause some anticipated difficulties querying customer records over time. However, this change in databases appeared to be a temporary problem typical of transitioning from one system to another. The change did not negatively affect program staff's ability to carry out their roles. However, the customer database does not provide the capabilities that a customer relationship management tool (CRM) could provide. Marketing staff would like the ability to target customers with messaging about efficiency opportunities and the new database does not offer this capability. According to staff, the ability to develop targets will happen at some unspecified point in the future.

Staff noted the following challenges facing Avista's nonresidential programs and expressed how they plan on meeting those challenges.

- Lighting: The change to a T8 baseline instead of T12 lowered participation because the savings are not as large for a T8 to LED replacement as they were for a T12 to LED replacement. Adding LED replacements for HID fixtures to the list of prescriptive lighting measures is one way the program plans to make the program attractive to potential participants.

  Additionally, the program is considering simplifying its online lighting calculator to improve customer satisfaction with that tool. The revised tool will help customers by providing estimated payback and help them determine whether their project will follow the prescriptive or site specific path. According to staff, this tool could help overcome customer frustration that occurs occasionally when a customer incorrectly submits a

prescriptive application instead of site specific. Staff also noted the tool could provide immediate quality control, making that process less time-intensive for them.

- Energy Smart Grocer: The market appears saturated as the program has delivered less savings each year over the last few years. Staff noted two possible ways to address this problem. 1) Develop deemed savings measures that would make it easier for customers to participate. 2) Encourage more participation among restaurants instead of concentrating on groceries and convenience stores, the programs traditional key participants.
- Site specific: Account executives currently play an important role in marketing the program to customers and contractors. Encouraging additional participation may require new avenues for marketing and outreach and further supporting account executives in their outreach role.

4.2 Program Awareness and Involvement

To identify how customers become aware of Avista's programs, the evaluation team asked participants, nonparticipants, and contractors how they learned about programs and about their reasons for participating and not participating. The sections below summarize each group's program awareness and provides some insights into motivations and concerns about program participation.

4.2.1 Contractor Involvement

Most of the 29 nonresidential contractors have been familiar with Avista programs for many years. Twenty-two of the 29 contractors surveyed reported having more than five years of experience implementing Avista-incented jobs. Of the remaining seven, four reported at least four to five years of Avista experience and three reported two to three years of experience.

The nonresidential contractors represented varying levels of activity. As expected, the lighting contractors tended to report doing more projects per year than the HVAC contractors (Figure 4-1).

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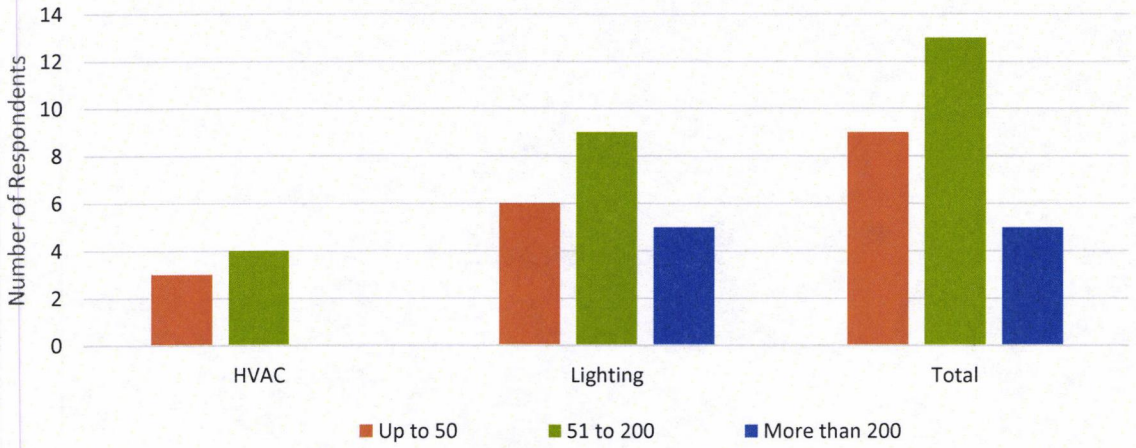
Figure 4-1: Nonresidential Contractor Activity Level



Twenty-four of the 29 nonresidential contractors surveyed were able to estimate the proportion of their commercial jobs that receive an Avista rebate. The evaluation team found that most of the surveyed contractors' work does not receive Avista rebates, with a mean of only 24% of jobs receiving a rebate. Most (19) respondents reported a quarter or fewer of their jobs receiving an Avista rebate. Of the remaining five respondents, one each reported that 50% and 75% of their work receives rebates and three (two lighting contractors and one HVAC) reported that all of their work receives Avista rebates.

The above findings indicate there is variability in the degree to which contractors are effectively using Avista's program, with some using them very effectively but more of them making little effective use of the programs. Section (4.4.4), below, further explores contractors' role in driving incented upgrades.

4.2.2 Nonresidential Customer Awareness

Nonresidential customers, 305 participants and 70 nonparticipants, were asked how they became aware of Avista's programs. Customers were allowed multiple responses.

Compared to nonparticipants that were aware of the program (n = 43), participants were more likely to have heard about the program through a contractor via the program website, and through past program experience. Compared to participants, nonparticipants were more likely to have heard about the program via printed material and other sources of awareness (Figure 4-2).

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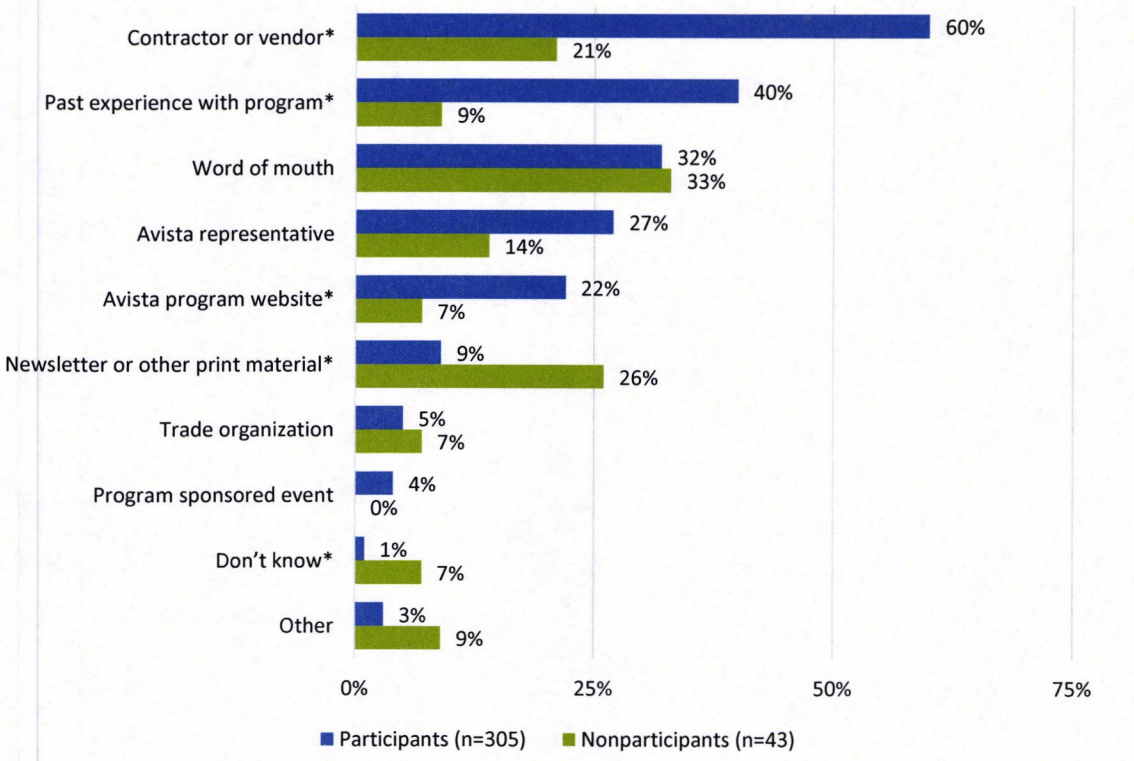
Figure 4-2: Source of Program Awareness (Multiple Responses Allowed)



*Significant ($p < .05$)

It is difficult to gauge the relative impact of each source of program awareness just by comparing the percentages of participants and nonparticipants that reported a source. For example, a fairly substantial percentage of participants reported word of mouth, but so did nonparticipants, so what does the comparison tell us?

The evaluation team developed a coefficient that better illustrates how strong the association was between each source of awareness and program participation. For each awareness source, the coefficient was the ratio between two percentages: 1) the percentage of participants among those who cited a source of program awareness; and 2) the overall percentage of participants in the population. For any given coefficient, the greater the value, the more strongly that source of awareness predicts program participation.

Figure 4-3 shows the coefficient for each source of awareness for program participants. This shows that awareness through past experience with the program was the greatest predictor of

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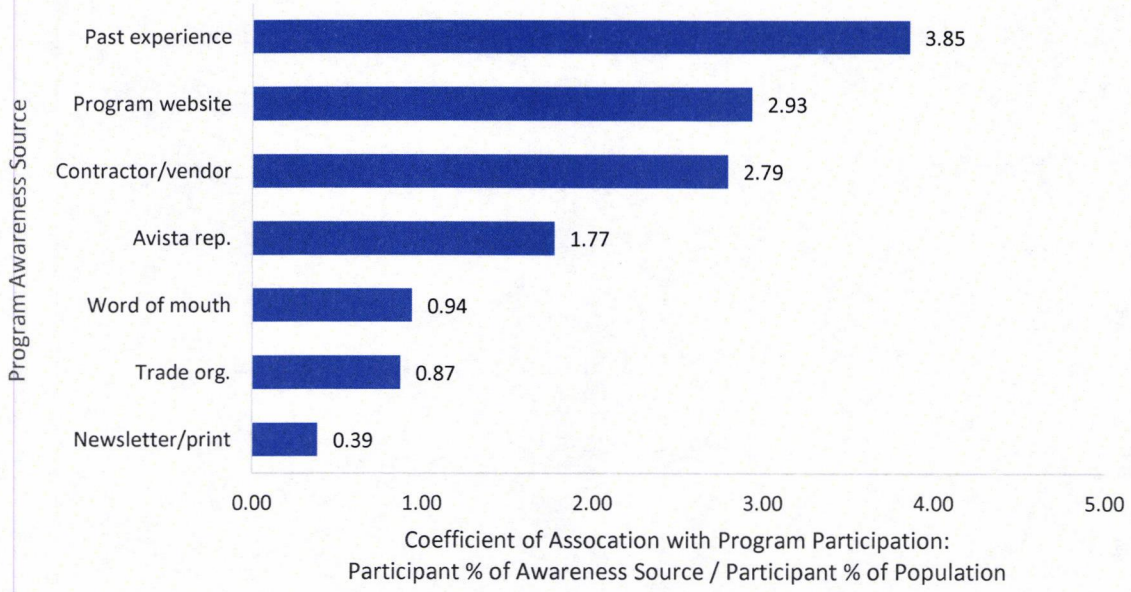
program participation.[15] More noteworthy perhaps is that awareness through a contractor or vendor was positively associated with program participation, as were awareness through the program website and through an Avista representative. Compared to the overall population, those who learned about the program through past experience are four times more likely to be a participant.

Figure 4-3: Relative Association of Participant Awareness with Participant Population



More than three-fifths of nonparticipants (57% in Idaho, 64% in Washington) reported being familiar with Avista rebates (Table 4-1). Nonparticipants primarily reported familiarity with prescriptive lighting rebates, followed by shell improvement and appliance rebates. They were far less aware of rebates for HVAC, and water heating.

[15] The evaluation team defined program nonparticipants as those who did not participate in 2014 or 2015, but some nonparticipants so defined could have participated in 2013 or earlier. This likely explains why some nonparticipants identified past program experience as their source of program awareness.

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Table 4-1: Nonparticipant Awareness of Avista Rebates (*n*= 70, Multiple Responses Allowed)

Rebates Familiar With	Count	Percent
Aware of any rebates	43	61%
Prescriptive Lighting	24	34%
Prescriptive Shell	8	11%
Appliances	7	10%
HVAC Program	4	6%
Motor Controls HVAC	1	1%
Hot water heater	2	3%
Other	3	4%
Don't know	7	10%

Participants and nonparticipants each expressed interest in future program participation. A slightly higher percentage of participants than nonparticipants expressed interest in learning more about efficiency programs and opportunities, but the difference was not statistically significant. Participants were more likely to express interest in attending a workshop or event about efficiency than were nonparticipants; this difference was statistically significant by chi-square ($p < .05$; Table 4-2).

Table 4-2: Interest in Future Participation (Multiple Responses Allowed)

	Nonparticipants (*n* = 70)		Participants (*n* = 305)	
	Count	%	Count	%
Interest in any future participation	47	67%	221	72%
Energy efficiency programs	45	64%	217	71%
Energy savings opportunities	45	64%	215	71%
Workshops or events about energy efficiency*	28	40%	170	56%

* Significant ($p< .05$)

Both nonparticipants and participants expressed interest in receiving Avista program information. While participants indicated they would prefer to receive program information via email over any other method, nonparticipants were almost as likely to want information via US mail (not as part of their bill) and they were more likely than participants to request information via mail (Table 4-3). As an overall percentage, participants and nonparticipants did not differ much in their preference for person-to-person contact. However, participants were more specific than nonparticipants when requesting direct person-to-person contact, reporting five different methods compared to just one for nonparticipants. The 32 participants who indicated a preference for person-to-person contact suggested such contact might occur at a webinar, community event, or training or by telephone – none cited more commonly than others.

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Table 4-3: Nonresidential Customer Preferred Method of Receiving Information from Avista (Multiple Responses Allowed)

Preferred Method of Contact	Nonparticipants (n = 47)		Participants (n = 305)	
	Count	%	Count	%
Email	27	57%	196	64%
By US mail separate from bill insert*	26	55%	72	24%
By US mail via bill insert	16	34%	71	23%
Avista website	5	11%	55	18%
Person-to-person contact	3	6%	32	10%
Through trade associations	-	-	5	2%
Don't know	-	-	7	2%
Other	2	4%	4	1%
Refused to provide contact method	-	-	21	7%

* Significant (p< .05)

4.3 Influences on Customers Decision Making

The evaluation investigated several topics relating to customer decision making, their proactivity toward energy efficiency and their motives for investing in efficient equipment.

4.3.1 Energy Practices and Policies

More than half of participants (57%) reported that their company had one or more energy-related policies compared to 40% of nonparticipants; this difference was statistically significant (Chi-square, p <.05). The most commonly reported specific practice was having an employee or employees responsible for monitoring or managing energy use, with 44% of participants reporting this practice compared to 17% of nonparticipants. A significant difference between groups also exists for purchasing energy efficient equipment and having energy and carbon related goals (Table 4-4).

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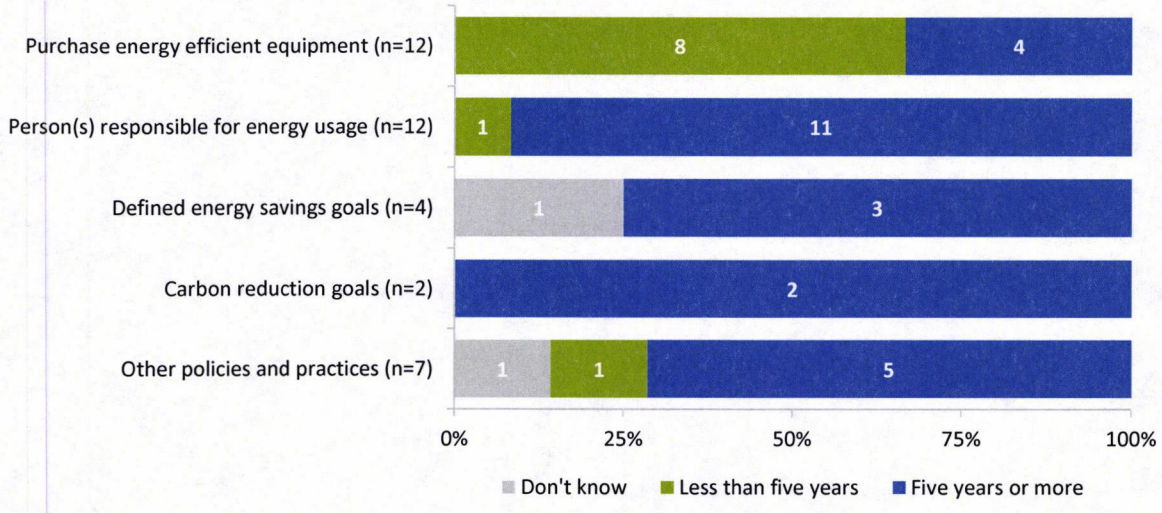
Table 4-4: Energy Savings Policies and Practices

	Nonparticipants (*n* = 70)		Participants (*n* = 305)	
	Count	Percent	Count	Percent
Any policy or practice	28	40%	175	57%
Person(s) responsible for energy use	12	17%	133	44%
Policy requiring energy efficient purchasing	12	17%	92	30%
Defined energy savings goals	4	6%	63	21%
Carbon reduction goals	2	3%	46	15%
Other[a]	7	10%	4	1%
Don't know/Refused	0	0%	2	1%

[a] Among nonparticipants that reported other policies, four reported offering general encouragement to staff on reducing energy, two reported having recycling programs, and one reported replacing current lighting with LEDs

The evaluation team also surveyed nonparticipants about the length of time their energy saving policies and practices were in place. Most nonparticipants who had policies or practices related to energy management reported that they had been in place for five years or more, with the exception of policies related to the purchase of energy efficient equipment (Figure 4-4). Of the 12 nonparticipants who reported awareness of Avista's energy efficiency programs, few indicated that their awareness influenced their companies' decision to implement energy management policies or practice (two or fewer providing a rating of 4 or 5 on a 5-point scale from "not at all influential" to "very influential").

Figure 4-4: Length of Time Energy Related Goals and Policies Have Been In Place at Nonparticipants' Organizations



Another indication of a company culture interested in energy efficiency is having staff with Builder Operator Certification (BOC). One nonparticipant (1% of sample) and 12 participants (4%) reported possessing BOC certification.

4.3.2 Customer Motives

The evaluation team investigated customer motives from the perspectives of both program participants and contractors.

Participants provided many reasons for applying for the program rebate. Topping the list of reasons were to save money and to save energy (Table 4-5). Washington participants were significantly more likely than Idaho participants to say that increasing the comfort of their facility was the reason for participating in a program (67% of WA participants compared to 54% of Idaho participants; $p < .05$).[16]

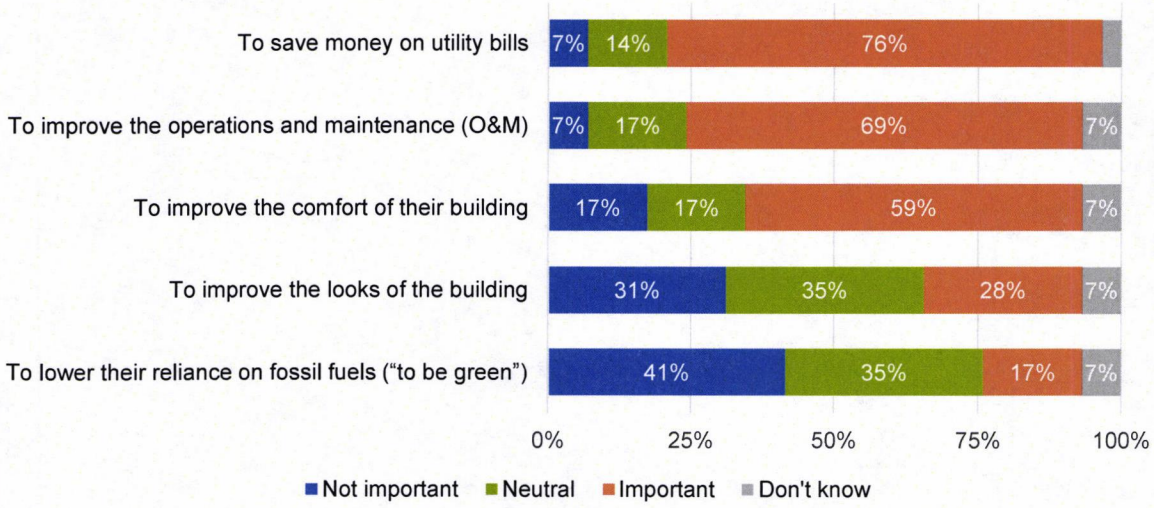
Table 4-5: Reasons for Applying to Program (Multiple Responses Allowed) (n = 305)

	Count	Percent
To save money	297	97%
To save energy	290	95%
Seemed easy to use program	217	71%
General trust of Avista programs	199	65%
Increase comfort of facility	193	63%
Good experience with another Avista efficiency program	190	62%
Contractor recommended	180	59%
Obtain high quality equipment	18	6%

Contractors also indicated that customers carry out incented jobs largely to save on their utility bills and to increase comfort levels (Figure 4-5). They also indicated that improving building operations and maintenance is an important motive. Neither contractors nor participants reported that being "green" was an important motive.

[16] We found no statistically significant comparisons for the other seven reasons for applying to the program. To control for Type I error across the eight comparisons, we examined the probability of finding a chi-square result with at least the observed level of statistical significance in the eight comparisons. A goodness-of-fit chi-square was not statistically significant, indicating that the one "significant" effect could have occurred by chance. Nevertheless, we have opted to present this finding as it is possibly meaningful, reflecting the fact that Washington participants, but not Idaho participants, may have had gas-related projects which are more commonly HVAC and comfort-related.

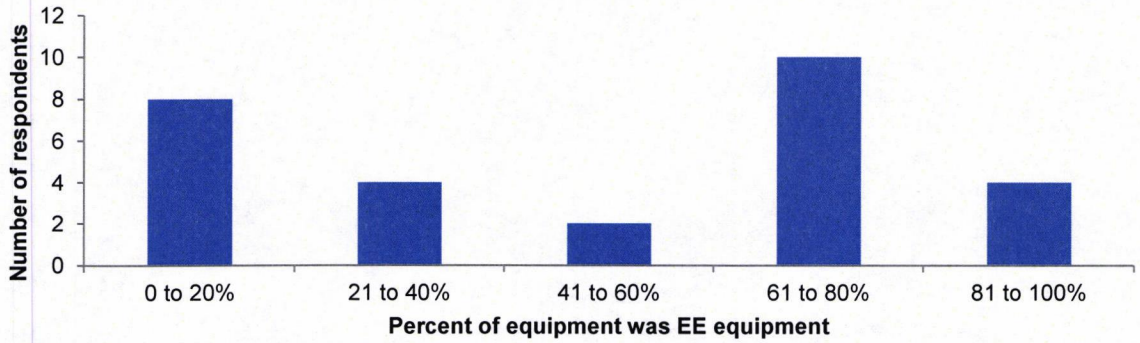
Figure 4-5: Contractor Perspective: Importance of Reasons Nonresidential Customers Implement Avista Energy Efficiency Projects (*n* = 29)



4.3.3 Contractors' Sales Practices

All but one surveyed contractor reported they did not recall ever discouraging a customer from ordering a high efficiency equipment option. (The one contractor who did recall doing so said that it was because the incentive was not sufficient to produce a good ROI on the higher-cost equipment.) Nevertheless, contractors varied greatly in how much of the equipment they sold is high efficient, from 5% to 95% of their sales. Figure 4-6 shows that most contractors fall into two groups: 1) those whose high efficient equipment sales represent more than 60% of their sales; and 2) those whose high efficient equipment sales represent 40% or less of total sales, most of whom reported that high efficient equipment makes up 20% or less of their sales.

Figure 4-6: Percentage of Equipment Sold (*n* = 28)[17]



[17] One respondent did not know the percent of their equipment sold that was high efficient.

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When asked how many equipment options they offer customers when bidding work, 26 respondents were able to report a specific number of options. Most respondents (22) reported offering two or three options, with the other four reporting they offer only one option. Respondents most frequently cited price (10 respondents) and energy efficiency (9 respondents) as the factors that differentiated the options they offer. Less frequently identified differentiators were differences in product quality or technical characteristics (4) and non-energy benefits (3). (Four respondents cited multiple differentiators.)

4.4 Program Experience

The section below describes the experience participants and contractors had using Avista programs. This includes participants' and contractors' satisfaction with the programs, their motivations to participate, and possible barriers to participation. This section also describes nonparticipants' reasons for not participating in the program.

4.4.1 Participant Program Satisfaction

Participants from all programs were generally satisfied with their participation, with no more than 5% of respondents reporting negative satisfaction with any element (Figure 4-7). This did not differ by year of participation or location (WA vs ID). For all but two elements, responses indicated that more than 80% of respondents thought the program provided an easy-to-use process and adequate equipment. The two exceptions were as follows:

- Of the 270 respondents that received rebates for equipment upgrades, 64% agreed that the project energy savings met or exceeded their expectations. However, many of these participants (27%) did not know whether the energy savings met or exceeded expectation, suggesting that it may have been too early for the respondent to know whether the project was delivering savings. Excluding those that did not know about the energy savings, 88% agreed the savings met or exceeded expectations.

- Of the 143 respondents that received lighting rebates, 78% reported that the range of eligible lighting equipment met their needs, while 16% reported some dissatisfaction with the range of lighting equipment. Shedding some light on this finding, program staff had noted challenges in keeping up a list of eligible equipment in the rapidly changing lighting market, particularly with growing interest in LEDs.

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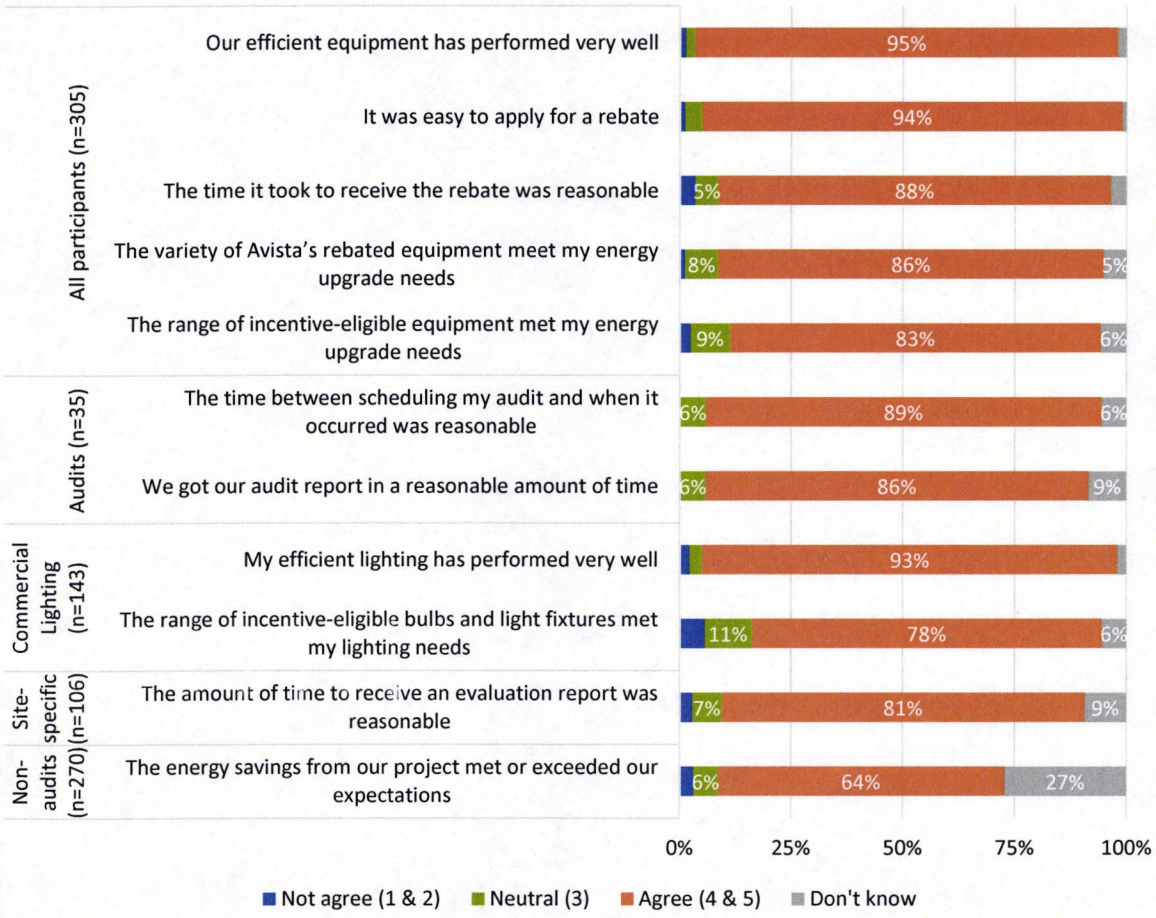
Figure 4-7: Satisfaction with Program Elements



To better understand what equipment changes might be useful for the program to consider, interviewers asked those that did not agree or were neutral about the range of rebate eligible equipment about possible changes to improve the range of equipment. Responses generally were not specific. One respondent requested more LED lighting options and three said that the lists were heavily weighted towards lighting measures but lacked other equipment types. Of the other 28 respondents, 14 indicated a general desire for more variety of equipment, one said there was an insufficient range of eligible "electric" equipment, and one said that program equipment often did not align with the list of equipment approved by their national franchise.

As noted above in Section 4.1, program staff reported possible plans to simplify the online lighting calculator to provide estimated payback and help identify the appropriate project path, possibly increasing customer satisfaction. This may be very valuable to customers, but considering that 94% of customers consider the application process easy, such a revision may not be completely necessary.

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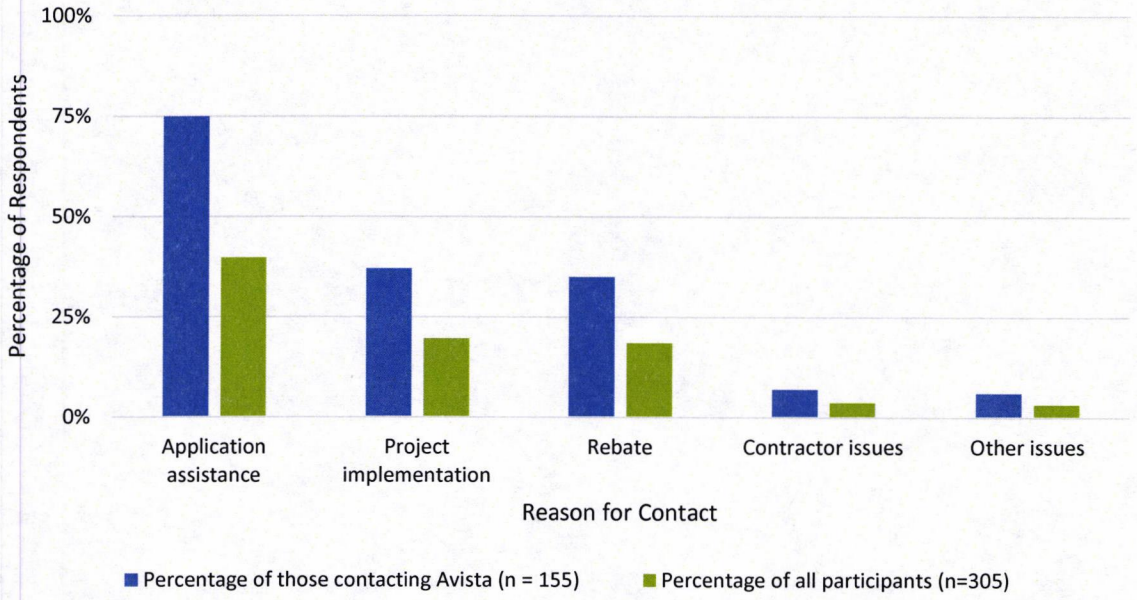
4.4.1.1 Satisfaction with Program Representatives

Participants who engaged staff or program representatives reported high levels of satisfaction across various situations. Just more than half of participant respondents (53%) reported having contact with an Avista representative, most commonly regarding their application. Other reasons included concerns or questions about project implementation or the rebate. Far fewer respondents reported contacting Avista representatives about contractors or other issues (Figure 4-8). Of the 155 respondents who had contact with an Avista representative, almost all (96%) agreed that the Avista representatives they worked with were courteous and helpful.

Figure 4-8: Reasons for Contact with Avista Representatives



Of the 95 participants that received on-site inspections for their prescriptive shell work or site specific work, all agreed the program representative was courteous and efficient when conducting the inspection. All 18 participants familiar with the on-site audit reported the auditor helped them understand energy efficiency opportunities and how to pursue those opportunities.

Audit participants generally reported their program experience would likely result in future actions. Of the 35 participants who received an audit, most (24) indicated they were in the process of implementing all (10) or some (13) of the recommendations (one did not know whether it was some or all). Of the remaining 11 participants, seven did not know whether any of the audit-related upgrades were planned or under way and four stated they would not implement any audit recommendations.

4.4.1.2 Application Preparation

Across both years studied, about half of all participants reported they prepared the information for the rebate, but this percentage was somewhat lower for 2015 participants than for 2014 participants (Figure 4-9). A larger percentage of 2015 respondents reported that their contractor

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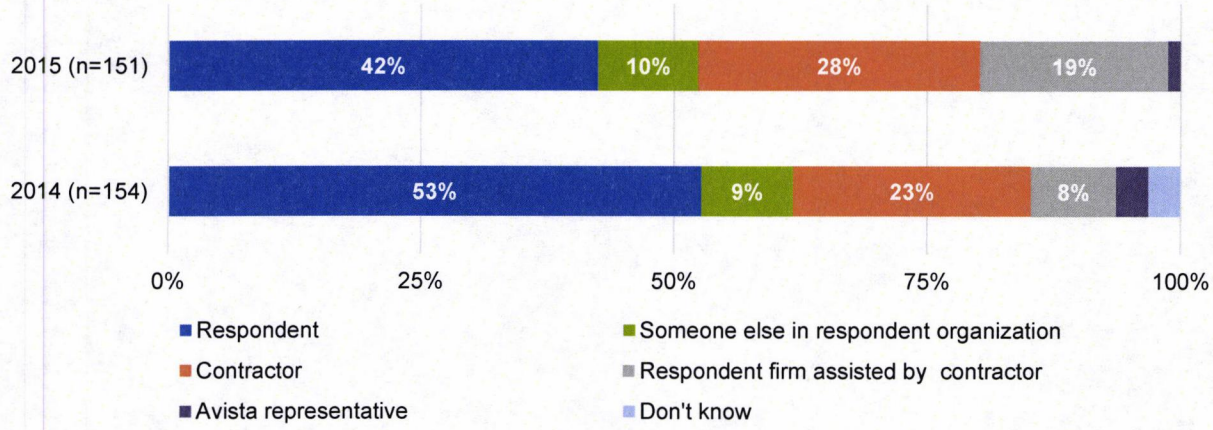
was involved in preparing the application than did 2014 respondents (47% vs. 31%; Chi-square, $p < .005$).[18] Similarly, Washington participants were more likely to receive assistance from their contractor than Idaho participants (16% vs. 6% respectively, Chi-square $p < .05$).

Figure 4-9: Who Prepared Application?

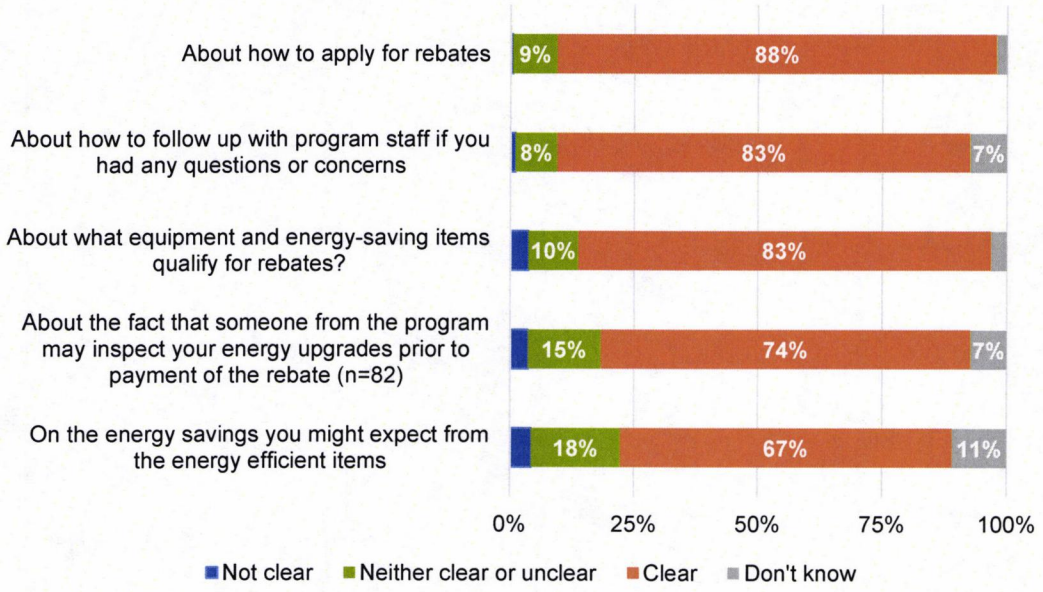


The above information is not completely consistent with contractors' reports that customers typically do not complete rebate applications without assistance from a contractor or distributor. Almost 80% of surveyed contractors (23) reported that the contractor completes the application (12), the respondent and the contractor complete the application together (8), or a third party such as a distributor completes the application (3). Possibly some of the difference between the participant and contractor responses reflects projects that customers self-installed, which the contractors would not know about. However, it is unlikely that this accounts for a large part of the discrepancy.

A total of 190 respondents reported they reviewed Avista program information. Of those, about three-quarters or more said that information from Avista was clear regarding how to apply, what equipment was eligible, and how to reach program staff for assistance. A somewhat lower percentage (67%) reported that the information on potential energy savings was clear (Figure 4-10).

[18] These percentages refer to the light green ("Contractor") and purple ("Respondent firm assisted by contractor") portions of each bar, combined.

Figure 4-10: Clarity of Avista Program Information (*n* = 190)



* This applies only to participants of programs with audits. Therefore the *n* for this is 82, not 190.

4.4.2 Contractor Program Satisfaction

The 24 contractors that reported any of their jobs received an Avista rebate reported their satisfaction with nine elements of the program across three areas: program-specific areas like rebates and measures, interactions with program staff, and program marketing.

Satisfaction levels varied across the program elements. Contractors reported highest satisfaction with how staff explains the program, the amount of rebates, and the ability of staff to resolve problems.[19] They were less satisfied with marketing and the range of qualifying products; overall, 22 reported they were less than satisfied with at least one element (Figure 4-11). Program staff reported that marketing is not widely conducted, particularly in the site specific program. Account executives conduct most customer and contractor outreach, which means that contractors do not see or at least are not aware of marketing efforts.

[19] Here, "satisfied" means they rated an item as four or five on a satisfaction scale ranging from one ("not at all satisfied") to five ("very satisfied"); "less than satisfied" means a rating of three or lower.

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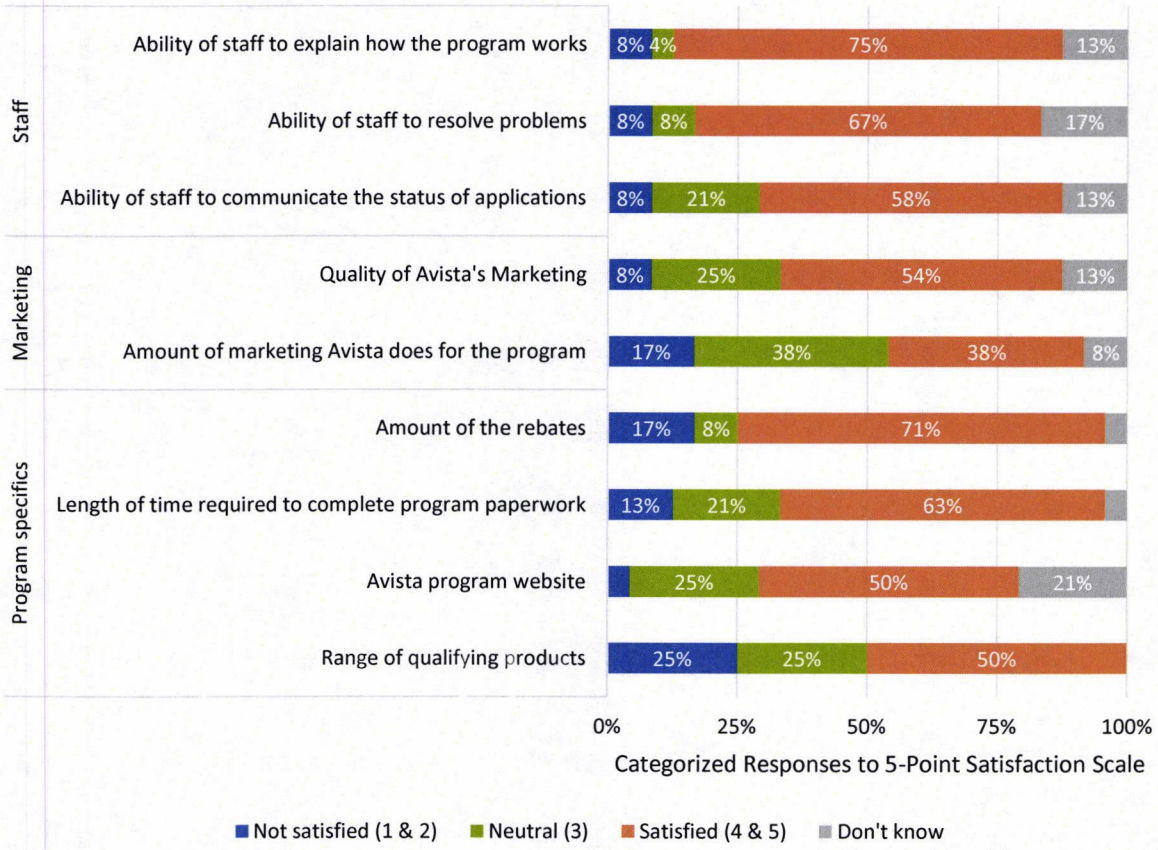
Figure 4-11: Commercial Contractor Satisfaction with Program Elements (*n* = 24)



The evaluation team asked all contractors that were less than satisfied with a program element to specify what they were dissatisfied with. Contractors identified the following issues:

- **Marketing.** Of the 14 who were less than satisfied about the amount of marketing Avista does, one suggested that Avista advertise the program in supply houses. The others provided no suggestions beyond that Avista should do more marketing directly to commercial customers.
- **Range of qualifying options.** Of the 12 that commented about the range of qualifying options, eight provided specific issues. Three did not approve of using the Design Lights Consortium (DLC) list because it excluded specific items. Two noted that the exclusion of T8s from the incented list hurt their business. Two others stated specific lights were not on the list – one reported specific LED fixtures that require onsite evaluation and the other noted 1000 watt LEDs are not covered.
- **Length of time required to complete program paperwork.** Eight contractors remarked that the time it takes to complete program paperwork, typically 4 to 6 weeks, is too long. One contractor reported it took his last customer four to five months to receive their rebate.

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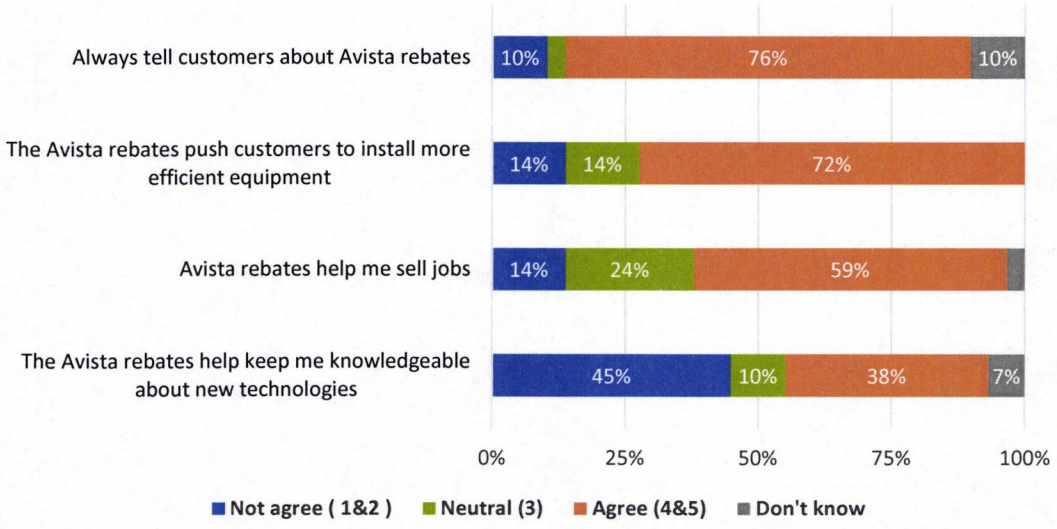
- **Avista program website**. Seven contractors had difficulty finding the information they needed on the website.
- **Amount of the rebates**. Six contractors reported the rebates were too small to motivate some customers to do projects. One of these contractors implied that in order to make up for the smaller rebates, installers are doing jobs for less profit than in the past.
- **Staff responses.** Seven contractors reported difficulties with staff not getting back to them when needed.
- **Ability of staff to explain the program or resolve problems.** Of five contractors noting some type of difficulty in this area, two noted staff were inflexible in their interpretations of installed work, while three simply reported generic problems communicating with staff.

4.4.3 Perceived Value of Rebates – Contractor Perspectives

Three-quarters of the contractors reported they always tell customers about rebates, and nearly as many said that rebates drive customers to install efficient equipment. Fewer contractors agreed that Avista rebates help sell jobs. This suggests perhaps that some contractors believe they would still be able to sell work without the rebates, but the work would not necessarily involve efficient equipment. Even fewer agreed that the program rebates help keep them knowledgeable about new technologies (Figure 4-12).

Figure 4-12: Contractor Perceived Value of Avista Rebates (*n* = 29)



The latter finding does not mean that the program does not in some way help to keep contractors knowledgeable about new technologies, just that the rebates themselves do not necessarily do that. Staff expressed interest in providing more education and training opportunities for contractors in the future. If more training occurs, future evaluations may demonstrate that the program rebates contribute to contractor knowledge.

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4.4.4 Driving Incented Upgrades – Contractor Perspectives

Contractors reported their and their customers' roles in initiating upgrade projects and communicating about rebates. When asked what percentage of upgrade jobs they and their customers initiated, contractors most commonly indicated that customers always or usually (at least 60% of the time) initiated upgrades, but one-third said that it was close to half customer-initiated and half-contractor initiated. The least common response was that the contractor initiates most or all upgrades (Table 4-6).

Table 4-6: Contractors' and Customers' Roles in Initiating Upgrades

Who initiates commercial upgrade jobs?	Count	Percent
Always contractor	2	7%
Usually contractor*	4	15%
Mixed	9	33%
Usually customer*	6	22%
Always customer	6	22%
TOTAL	**27**	**100%**

*Usually = at least 60% of the time.

Surveyed contractors reported the percentage of customer-initiated upgrade jobs in which the customer asked about rebates and, conversely, the percentage of contractor-initiated upgrade jobs in which the contractor (or their staff) told the customers about the rebates. This provides additional information about the importance of whether customers or contractors initiate upgrades: if customers do not ask about rebates when they initiate upgrades, then it is important for Avista to ensure that contractors always tell their customers about the rebates.

Findings from the contractor survey show that customers do not commonly ask about rebates when they come to the contractor with an upgrade idea. By contrast, contractors reported that they do usually tell their customers about the rebates when they themselves suggest the upgrade idea (Table 4-7).

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Table 4-7: Contractors' and Customers' Roles in Discussing Rebates

Percentage of jobs	In what percentage of...			
	...customer-initiated jobs do customers ask about rebates?		...contractor-initiated jobs do contractors tell about rebates?	
	Count	Percent	Count	Percent
0%	3	10%	7	24%
1% to 25%	16	55%	0	0%
26% to 50%	5	17%	4	14%
51% to 75%	1	3%	1	3%
76% to 100%	4	14%	17	59%
TOTAL	**29**	**100%**	**29**	**100%**
MEAN	**30%**		**65%**	

Simultaneously considering both of the above sets of questions – what percentage of projects are contractor- or customer-initiated and what percentage of contractors and customers take the initiative in discussing rebates when they initiate the upgrade discussion – provides additional information, including a more meaningful look at the contractors' role in driving incented upgrades.

For one thing, looking at all the data together presents a different perspective of the roles that contractors and customers have in driving the rebate discussion than the above table shows. Of the 24 contractors who answered all of the pertinent questions, 13 reported both that they told customers about rebates in at least 75% of the jobs they initiated *and* that customers asked about rebates in 25% or fewer of the jobs the customers initiated. Thus, for just more than half of contractors, the rebates likely would not get discussed unless they brought them up.

So how often do rebates get discussed? For each contractor, the percentage of upgrades in which rebates are discussed is the sum of two products: 1) the percentage of customer-initiated jobs times the percentage of those jobs where the customer asks about rebates; and 2) the percentage of contractor-initiated jobs times the percentage of those jobs where the contractor tells the customer about rebates. For the 24 respondents that provided all those data, this analysis indicates that, on average, rebates are discussed in 57% of upgrade jobs. This is more than double the mean percentage of jobs that actually *receive* rebates (reported in Section 4.2.1, above), suggesting that less than half of potential jobs in which rebates are discussed actually become incented upgrades. A deeper investigation into the process from initial discussions between the contractor and customer through installation of incented high-efficiency equipment may prove fruitful in future evaluation research.

Table 4-8 shows a final perspective on the relative roles that contractors and customers play in driving incented upgrades according to contractors. The evaluation team coded responses as indicating whether customers and contractors each played a large, mixed, or small role.

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Responses indicate that contractors are much more likely than customers to play a large role in driving rebate upgrades, while customers are much more likely to play a small role.

Table 4-8: Contractors' and Customers' Relative Roles in Driving Incented Upgrades

Size of role	Customers...	Count	Contractors...	Count
Large	...initiate jobs ***and*** ask about rebates at least 50% of the time	5	...initiate jobs ***and*** tell about rebates at least 50% of the time	14
Mixed	...initiate jobs ***or*** ask about rebates at least 50% of the time	18	...initiate jobs ***or*** tell about rebates at least 50% of the time	10
Small	...initiate jobs ***and*** ask about rebates less than 50% of the time	5	...initiate jobs ***and*** tell about rebates less than 50% of the time	1

4.4.5 Participant Concerns

Six percent of participants (19 of 305) reported they had had some concerns at some point about their participation in the program. Twelve reported concerns relating to program processes, four expressed concern that the rebate would be inadequate, two noted concern about the quality of products, and two others expressed concern about the range of products available. Of the 19 expressing some concern about participation, 12 suggested that their contractor (6) or an Avista representative (6) helped alleviate their concerns about participation.

4.5 Opportunities for Increasing Program Participation

Avista staff have considered ways to increase program participation, such as continuing to move often-used Site Specific measures into the prescriptive measures list, developing deemed savings measures for the existing Energy Smart Grocer program and expanding outreach to restaurants, and mining customer data to better target customers for efficiency programs.

To assess possible opportunities for the program, the evaluation team asked nonparticipants about recent building upgrades and future plans for upgrades. Lighting and HVAC upgrades were the most commonly cited recent upgrades, and more nonparticipants reported installing efficient lighting than efficient HVAC equipment.

A total of 43 of the 70 (61%) surveyed nonparticipants reported either that they had upgraded equipment or building features in the past two years (n = 34) or that they planned to do so in the next two years (n = 20). An additional 17 respondents said they were not sure whether or not they would upgrade equipment, while about half of the respondents (n = 33) said they do not plan upgrades in the next two years. Of the past and planned upgrades, a little more than half of were for lighting or lighting controls, with HVAC representing the next most common equipment type (Table 4-9).

Table 4-9: Equipment Replacements or Upgrades Made by Nonparticipants in Past Two Years or Planned for Next Two Years (Count and Percent of Total)

Equipment or Upgrade	Upgraded (*n* = 34)		Plan to Upgrade (*n* = 20)		Upgraded and/or Plan to Upgrade (*n* = 43)	
Lighting or lighting controls	23	(68%)	11	(55%)	29	(67%)
Heating, cooling, HVAC	7	(21%)	6	(30%)	10	(23%)
Building shell [a]	4	(12%)	2	(10%)	5	(12%)
Water heating	4	(12%)	3	(15%)	6	(14%)
Motors or motor controls	3	(9%)	1	(5%)	3	(7%)
Food processing and storage	2	(6%)	0	(0%)	2	(5%)
Other	3	(9%)	4	(20%)	7	(16%)

[a] Includes insulation (attic, ceiling, and wall) and windows.

Of the 34 nonparticipants who reported recent equipment or building upgrades, 25 (74%) said they selected an energy efficient version.[20] Similarly, 17 of the 20 nonparticipants (85%) who *planned* future equipment or building upgrades affirmed that they were considering using above-standard-efficiency equipment, while the other three said they were unsure what equipment they would select or that they might select energy efficient equipment if the cost was not too high. A total of 34 – half of the respondents – reported they either did use or planned to incorporate energy efficiency in an equipment upgrade.

Respondents rated the influence of various factors on their decision to carry out energy efficient upgrades and/or on their plans to do so. Increasing comfort, reducing O&M costs, and increasing productivity were most commonly cited as being influential, and Avista marketing was least influential (achieving a green image and contractor/vendor recommendations had intermediate levels of influence; Table 4-10).[21]

[20] Four respondents reported that they received financial incentives from utilities or government agencies for their upgrades – three, for lighting or lighting controls and one, for unknown equipment.

[21] Here, "influential" means they rated influence as a 4 or 5 on 1-5 scale, where 1 was "no influence" and 5 was "great influence;"

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Table 4-10: Factors Influencing Nonparticipants' Recent or Planned Purchase of Energy Efficient Upgrades

Equipment or Upgrade	Count of Respondents Rating Each Factor as Influential [a]					
	Increasing comfort	Reducing O&M costs	Increasing product-ivity	Achieving a "green" image	Avista Marketing	Contractor or vendor
Recent upgrades (*n* = 38)						
Lighting/lighting controls (*n* = 18)	3	14	6	5	1	7
Non-lighting (n = 9)	7	6	6	4	2	4
Planned upgrades (*n* = 17)						
Any planned upgrade (*n* = 17)	9	15	9	10	7	6

[a] "Influential" is defined here as a rating of 4 or 5 on a 5-point scale, from "no influence" to a "great influence."

The small samples sizes argue for caution in comparing the ratings for past and planned upgrades or those for lighting and non-lighting upgrades. Nevertheless, one comparison is worth mentioning. Three-quarters of respondents who did non-lighting upgrades cited "increasing comfort" as influential; by contrast, the proportion was closer to one in six for those who did lighting-related upgrades. The idea that upgrading HVAC or building envelope can produce greater comfort may seem obvious, while associating lighting with increased comfort may seem less so – nobody puts on a sweater because of poor lighting. However, research has demonstrated that lighting is an important factor in workplace comfort and satisfaction.[22] Given that employee comfort is a motive for upgrading other equipment types, messaging that cites proper lighting as a comfort issue, and not just a productivity or cost issue, may help motivate greater uptake of energy efficient lighting.

Of the nonparticipants who reported plans for energy efficiency upgrades in the next two years, ten reported it was likely their organization would apply for Avista rebates, and two were not sure whether it was likely or not.[23] Of the five who indicated they were unlikely to apply for Avista rebates, one indicated it was because they rely heavily on propane. The other four did not provide clear reasons: one said that the use of rebates was "not part of their policy directive" but did not explain why, two said it was because of lack of awareness of the rebates, but they did not clarify the likelihood of applying would change now that they were aware of the rebates, and one did not provide any reason at all.

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[22] See, for example, a summary of research conducted at Cornell University: http://ergo.human.cornell.edu/lighting/lilstudy/lilstudy.htm. Accessed on April 6, 2016.

[23] "Likely to apply" = a score of 4 or 5 on a scale where 1 equaled not at all likely to participate and 5 equaled very likely to participate.

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The six nonparticipants who did not do efficiency upgrades as part of their equipment replacements either said they lacked capital (two mentions) or they did not prioritize energy efficiency, were not aware of efficient options or incentives, or did not find efficient equipment that matched their needs.

4.6 Freeridership and Spillover

This section summarizes results about freeridership and spillover, two key aspects of energy efficiency programs. Freeridership represents an estimate of the energy savings that the program participants would have achieved without the program's assistance, and spillover is what additional energy saving actions occurred outside the program but as a result of program influence. For a discussion of the methods used to calculate freeridership and spillover values, see the 2014-2015 impact report discussion about net-to-gross calculations. Additionally, the impact report covers how freeridership and spillover rates affect savings.

This section discusses freeridership first and spillover second.

4.6.1 Freeridership

The evaluation team examined freeridership for three nonresidential programs: Prescriptive, Energy Smart Grocer, and Site-Specific. Figure 4-13 shows the PY2014 and PY2015 freeridership results, weighted by program savings, plotted next to the weighted results reported in the previous evaluation.[24] The figure shows a general trend toward increase freeridership over time, except for the values for PY2011.

[24] Avista 2012-2013 Process Evaluation Report, May 15, 2014. Submitted by Cadmus to Avista Corporation. The previous evaluation did not report freeridership values for PY2012.

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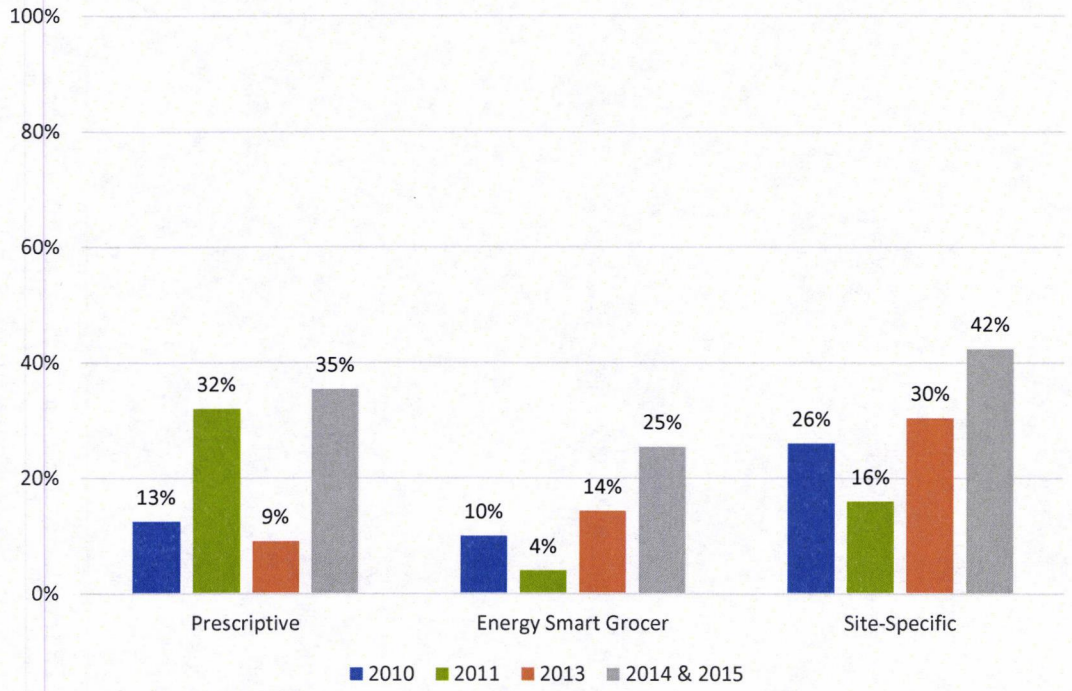
Figure 4-13: Freeridership Values Over Time



The previous evaluation attributed year-over-year changes in freeridership from 2010 to 2013 to a small number of participant scores having large effects on the program freeridership score because of the size of their project savings. Freeridership scores are weighted by savings and the highest saving projects in the sample can have a strong influence on freeridership scores. Not discounting the possibility that some of the increase in freeridership in PY2014 and PY2015, relative to those from prior years, may to some degree reflect different methodologies used to calculate freeridership, the evaluation team below has identified some possible explanations for some of the observed variability over time in freeridership. These explanations are hypotheses that would require additional analysis and research to verify.

4.6.1.1 Prescriptive

The dip in freeridership from 2011 to 2013 could reflect the removal of T12s as a baseline lighting measure in 2012. Prior to December 2012, freeridership may have increased as customers interested in replacing their T12s took action in 2011 and 2012 to maximize their rebate amount before the baseline change to T8s lowered rebate amounts. According to this hypothesis, many of those customers would have replaced their T12s anyway, and so were freeriders or partial freeriders. After the baseline changed in 2013, freeridership then declined (according to this hypothesis) because many of the T12 customers – likely partial freeriders – were no longer participating, leaving mainly customers who really needed the incentives to carry out the upgrades.

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The uptick in freeridership seen in 2014 & 2015 could reflect the success of Avista's programs in transforming the market over time. Another possibility is that the increase in affordable LEDs over the last two years, in conjunction with rebates, may be spurring customers – likely partial freeriders – to take action earlier than they otherwise would.

4.6.1.2 EnergySmart Grocer

The general trend in freeridership for the Energy Smart Grocer program is increasing over time. This increase in freeridership co-occurs with declining participation rates in the program over the last five years. In the earlier years of the program, freeridership may have been low because the program was reaching grocers that were unaware of savings opportunities and were therefore heavily influenced by the program – they were low freeriders – to take action. With the program well established after several years of operation, possibly driving an increase in general awareness of efficiency opportunities, one might expect to see an increase in freeridership as more grocers are aware of energy saving opportunities and thus more likely to be interested in participating.

4.6.1.3 Site Specific

The general trend in Site-Specific freeridership shows an increase over time. The explanations for the increase in Prescriptive program freeridership and Energy Smart Grocer rates also apply here. As Avista's programs mature, awareness of efficiency opportunities increases in the market, which in turn drives up freeridership rates.

Additionally, the LED lighting issue discussed in section 4.6.1.1 may also apply to site-specific participants. The increased affordability of LEDs combined with the rebate prompts customers considering a lighting upgrade to make that upgrade sooner making them partial freeriders and driving the freeridership rate up.

4.6.2 Participant Spillover

Participant spillover occurs when program participants elect to conduct energy saving activities outside of the program as a result of program influence. Because the actions took place outside of the program, the program has no mechanism to capture these actions other than during customer surveys. The analysis below shows how many participants reported they took a spillover action. For an analysis and discussion of what effect these actions had on savings, see the PY2014 and PY2015 impact report.

Of the 305 participants in the sample, twenty reported they were partially (10) or fully (10) influenced by the program to undertake an energy efficiency project that did not receive a rebate. Ten of the spillover participants took part in the prescriptive program (6%) and the other ten took part in the Site-Specific program (9%). No Energy Smart Grocer participant reported taking a spillover action (Table 4-11).

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Table 4-11: Number of Participants Reporting a Spillover Action

Program	Total Participants in Sample	Participants Who Did Spillover Project	Percent of Participants Who Did Spillover Project
Prescriptive	164	10	6%
Energy Smart Grocer	35	0	0%
Site-Specific	106	10	9%
TOTAL	**305**	**20**	**7%**

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5 Small Business Process Results

5.1 Small Business Process Evaluation Overview

The primary goal of the Small Business (SB) process evaluation was to assess and provide information on program delivery and implementation and market response to the program. The evaluation focused on program design and theory, implementation and delivery, and market feedback.

5.2 Summary of Program Data

In 2015, the program served 1,181 customers. All 1,181 customers received a basic, HVAC, and lighting audit to determine savings opportunities and 1,013 (86%) received at least one direct install measure.

Program staff target specific zip codes when conducting audits and installations. As of the end of 2015, staff conducted audits largely in the Spokane area (69%) followed by the territory south of Spokane (16%) and the area north of Spokane (15%) (Figure 5-1). As noted earlier, program staff did not do work in Idaho but anticipate doing so in 2016.

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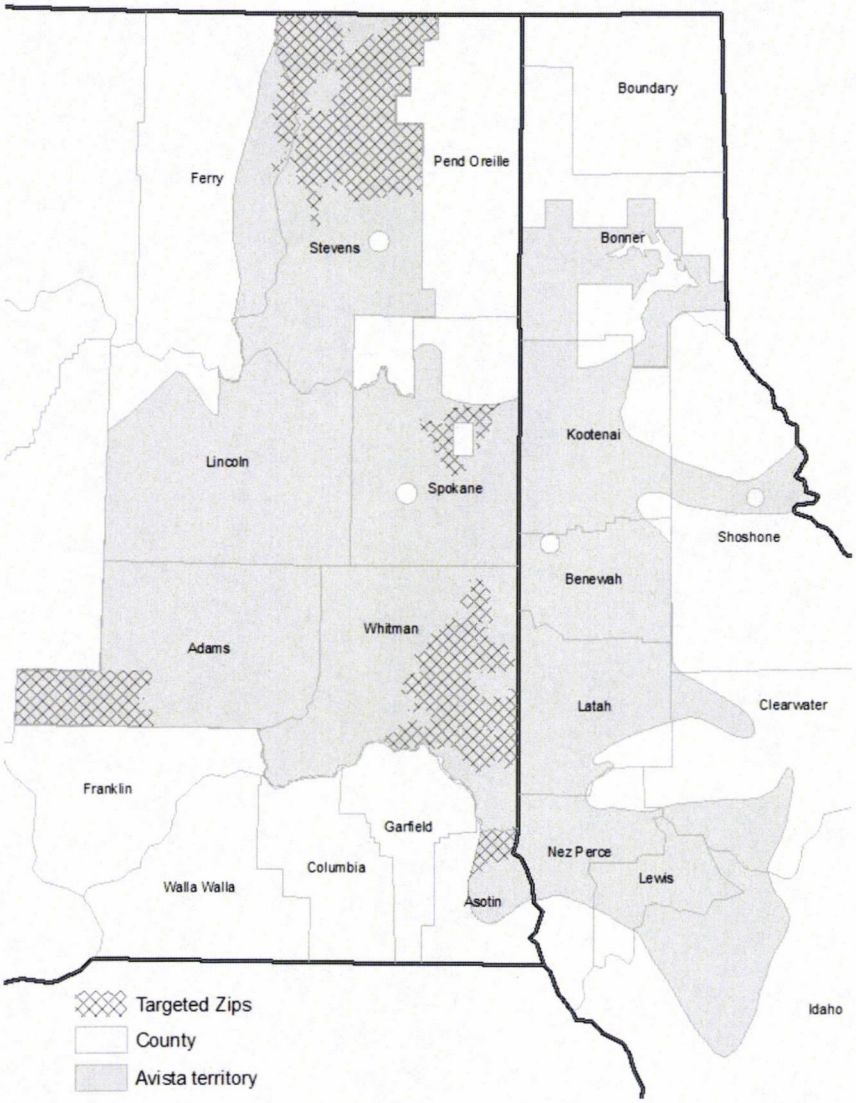
Figure 5-1: Areas targeted by SB program in 2015



Overall, the program is meeting its participation estimates by exceeding estimated participation in some areas and not meeting expectations in other areas. For example, the program exceeded its overall lighting and audit estimates having installed 2,781 LED bulbs when they anticipated installing 1,000 in 2015 and conducting 3,543 audits when anticipating 3,000. The program did not meet its estimates in water saving items by installing 2,851 items compared to their estimate of 4,325. Including audits as a "measure" the program exceeded the number of all measures they anticipated for 2015 by 518. Excluding the audits by counting only installed items, the program almost achieved its 2015 estimate perfectly by installing 15 units shy of the expected number (Table 5-1).

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Table 5-1 Participation to Date Compared to Estimated Participation

	Actual Participation	Estimated Participation			
	2015	2015	2016	2017	Total
Water saving measures	**2,851**	**4,325**	**8,650**	**4,325**	**17,300**
Faucet Aerator (.5 and 1 GPM)	2,561	4,000	8,000	4,000	16,000
Shower Head (incl. Fitness Center)	147	250	500	250	1,000
Spray Valve	143	75	150	75	300
Plug load devices	**778**	**1,100**	**2,200**	**1,100**	**4,400**
CoolerMiser	277	75	150	75	300
VendingMiser	106	25	50	25	100
Tier 1 smart power strip	395	1,000	2,000	1,000	4,000
Lighting	**2,781**	**1,000**	**2,000**	**1,000**	**4,000**
Screw-in LED lamp (A-line 40W)	528	[a]	[a]	[a]	[a]
Screw-in LED lamp (A-line 60W)	508	[a]	[a]	[a]	[a]
Screw-in LED lamp (A-line 75W)	5	250	500	250	1,000
Screw-in LED lamp (A-line 100W)	129	250	500	250	1,000
Screw-in LED lamp (BR30)	802	125	250	125	500
Screw-in LED lamp (BR40)	180	125	250	125	500
Screw-in LED lamp (PAR30)	393	125	250	125	500
Screw-in LED lamp (Par38)	236	125	250	125	500
Audits	**3,543**	**3,000**	**6,000**	**3,000**	**12,000**
Basic	1,181	2,000	4,000	2,000	8,000
HVAC	1,181	500	1,000	500	2,000
Lighting	1,181	500	1,000	500	2,000
Total measures including audits	**9,953**	**9,435**	**18,850**	**9,425**	**37,700**
Total measures excluding audits	**6,410**	**6,425**	**12,850**	**6,425**	**25,700**

[a] The program did not provide estimates for these two measures.

5.3 Staff and Implementer Interviews

The evaluation team interviewed the Avista SB program manager, the SBW program manager, the SBW field manager/auditor/installer, and SBW auditor/installer in December 2015 to better understand the program. The interviews covered program goals and plans, implementation and delivery, marketing and outreach, and program successes. The outcomes of the interviews are summarized in the following subsections.

5.3.1 Program Goals and Plans for the Future

The program aims to serve customers that are typically hard to reach, such as "mom and pop" operations. Typically this excludes national and regional chains that receive services via traditional efficiency programs. A primary emphasis of the program is to develop interest in other

Avista programs and identify savings opportunities. Staff reported many opportunities for lighting upgrades, particularly replacing T12s[25], and upgrading food service equipment.

Currently, the program's exclusion of national accounts can exclude franchises owned by a "mom and pop" operator. The program may consider expanding services to franchisees.

The program elected not to extend service to Idaho in 2015 because gas saving measures were deemed not cost effective and, therefore, the program could not claim gas savings. Idaho is reassessing gas measure cost effectiveness in 2016, at which point the program hopes to begin serving the state.

The program is interested in doing a pilot study offering Tier II smart strips to customers.

5.3.2 Implementation and Delivery

The program initially targeted the Spokane area to allow Avista staff to easily attend inaugural site visits and work out any potential problems that can arise in early implementation of a new program. Staff reported few problems in the early stages of the program and all reported successful and adequate amounts of communication between Avista and SBW.

The auditors/installers pass leads to other Avista program staff, relying on their assessment of the participant's likelihood to proceed with another program. According to both Avista and SBW staff, the auditors/installers have struck the right balance of providing good leads to Avista without overwhelming Avista staff with leads unlikely to result in projects.

Auditors/installers pay close attention to the hours a business uses its lights before installing lighting measures. Lights are not installed where the existing lights are used less than 60 hours per week, as such replacements would not be cost effective.

5.3.3 Marketing and Outreach

Auditors/installers conduct almost all program marketing through door-to-door outreach efforts. Occasionally program staff receive leads from other small businesses that heard about the program via a colleague or neighboring small business.

Avista provides a list of Schedule 11 customers that SBW uses to target potential participants. In the rare occurrence an auditor/installer sees a business not on the list that looks like it qualifies, they can seek permission from Avista to reach out to the business. Permission is typically granted quickly. Auditors/installers try "multiple attempts" to reach targeted small businesses before giving up on a site.

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[25] Program data shows that 35% of SB participants had T12 lights in place.

5.3.4 Program Successes

According to program staff, customers rarely reject items and the program data reviewed by the evaluation team supports their assertion. There were two cases where customers refused a specific recommended item and 18 decommissioned items[26] out of the original 6,428 installed.

Once approached by staff, very few small business participants refuse the service. According to staff, as of mid-December 2015, 12 of about 1,000 potential participants refused. Typically these refusals are because the auditor/installer could not ultimately reach a decision maker in the business or because of general suspicion of the program.

Staff reported the SB program offers strong customer service and relationship building between Avista and its SB customers. For example, according to staff, businesses were particularly "grateful" for the outreach from their utility immediately following the November 2015 windstorm that left 200,000 businesses without power. Staff also noted that a key trait required of the auditor/installer is someone with "excellent" customer service skills who can serve as an "ambassador" for the utility by relating to people and meeting with participants when it is convenient for them.

5.4 Participant Surveys

The participant survey covered how respondents learned about the program, their rationale for participating, energy saving topics discussed with the installer, program satisfaction, and plans for future upgrades. The evaluation team covers these topics below starting with a profile of respondents and their businesses.

5.4.1.1 Business Characteristics

Respondents represented a variety business types with a variety of energy using types of equipment. Retail establishments and offices represented close to half of all survey respondents followed by warehouses, auto repair shops, and food service establishments. All respondents had heating equipment and almost all had water heating, computers, and cooling equipment (Table 5-2).

[26] Staff removed eight .5 gpm aerators, eight spray vales, one CoolerMiser, and one VendingMiser after installation due to customer complaints about the measure. Customers, particularly dishwashers, were dissatisfied with the water pressure post installation. It was unclear why the participants were dissatisfied with the Misers.

Table 5-2: Small Business Respondent Characteristics (*n* = 34)

	Count	Percent
Business Types		
Retail	8	24%
General office	7	21%
Warehouse/wholesale	4	12%
Auto/truck repair	4	12%
Food service (restaurants)	3	9%
Personal services (spa, salon, gym)	2	6%
Medical or dental	2	6%
Small production	2	6%
Small grocery	1	3%
Religious institution	1	3%
Energy Using Equipment		
Heating equipment	34	100%
Water heating equipment	33	97%
Electric water heating	*17*	*50%*
Gas water heating	*16*	*47%*
Computer and office equipment	33	97%
Cooling equipment	32	94%
Refrigerator	28	82%
Air compressor	8	24%
Ventilation fans	7	21%
Freezer	5	15%
Cooking equipment	4	12%
Other	3	9%

5.4.1.2 Program Marketing and Rationale for Participation

The evaluation team conducted the surveys with SB owners, managers, or other people in a leadership at the business. Almost all reported learning about the SB program through an in-person visit (26 of 34) or a phone call from a program representative (5 of 34). The remaining three respondents did not remember how they heard about the program.

Respondents chose to participate for a myriad of reasons. More than two-thirds of respondents (23 of 34) reported two or more reasons for participating in the program. Most commonly

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respondents elected to participate to save money on their energy bills (59%) or for equipment-specific reasons (47%; Table 5-3).[27]

Table 5-3: Reasons for Participating in SB Program (*n* = 34)

	Count	Percent
Saving money on energy bills	20	59%
Equipment-related reasons	16	47%
Get free equipment	12	35%
Acquire the latest equipment	2	6%
Seek improved lighting	2	6%
Learn more about energy efficient lighting	2	6%
Conserving energy/protecting the environment	10	29%
Representative was convincing	3	9%
Overall positive for store	1	3%

In addition to the reasons for participating, shown above, 18 respondents (53%) said they participated because participation was easy. Ease of participation is not in itself a reason to participate – it does not offer any specific benefit. But these responses provide important feedback about the process, namely that an easy participation process encourages participation. Three respondents gave no reason for participating other than that it was easy.

Respondents largely had not considered installing SB measures prior to the program. Four of the 34 respondents stated they considered upgrading the efficiency of their lights, and no respondent noted considering water or power saving upgrades such as aerators or power misers. Of the four that considered lighting upgrades, three stated it was unlikely they would have made the change without the program and one reported it was likely.

5.4.1.3 Energy Savings Discussions with Installer

To understand how the interactions with the assessor helped them decide what equipment to replace, the survey asked respondents what they discussed with the assessor. More than three-quarters reported discussing lighting upgrades, mainly about the type or quantity of lighting to be replaced (Table 5-4). A minority of those who mentioned lighting indicated that they had discussed past Avista-supported lighting upgrades with the assessor. Other common discussion topics were the expected energy savings from upgrades and water-saving measures. Far fewer respondents indicated that they discussed prioritization of energy-saving projects or about equipment cost.

[27] Ultimately, the equipment-related reasons likely are not really the ultimate motives. It is likely that these responses signify one of the other motives that were stated more explicitly, namely, saving money or environmental reasons.

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Table 5-4: Topics Discussed with Installer (*n* = 34; Multiple Responses Allowed)

	Count	Percent
Lighting upgrades	27	79%
Type of lights/fixtures to be replaced	20	59%
Quantity of lights/fixtures to be replaced	13	38%
(Past) fluorescent replacement [a]	6	18%
Quality of lights/fixtures	4	12%
Energy savings resulting from installed equipment	16	47%
Water measures	11	32%
Prioritization of energy-saving projects	4	12%
Plug load	1	3%
Equipment cost	1	3%

[a] The current SB program does not incent fluorescent lighting; the context of some of the comments indicated that this refers to a previous fluorescent change-out.

More than half (20 of 34) of respondents reported that the installer recommended energy-saving projects outside the scope of the SB program. Of those 20, most reported the installer recommended lighting changes (15), including one specifying motion sensors. Four reported that the installer recommended HVAC upgrades, two said the installer recommended a refrigeration control unit, and two did not recall the recommendation. No respondent suggested the program should supply additional equipment.

5.4.1.4 Program Satisfaction

Participants tended to be satisfied with all aspects of the program other than the energy savings resulting from program participation. In that case, most participants reported not knowing what savings, if any, resulted from the program measures.

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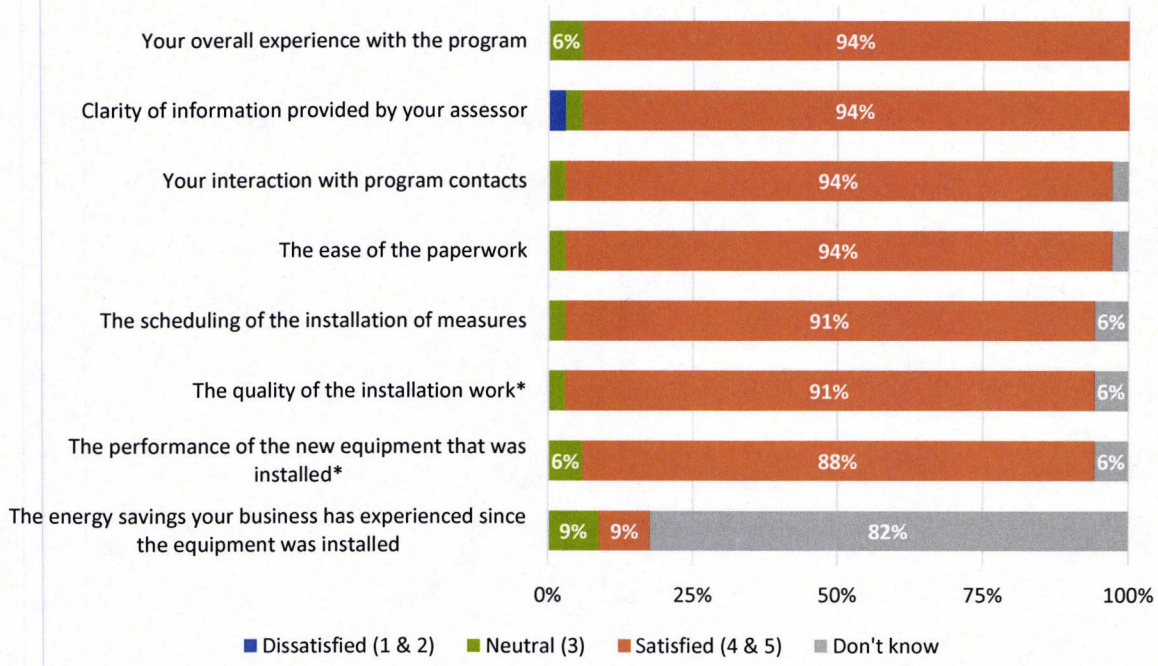
Table 5-5: Satisfaction with Program Elements



Of the five respondents reporting they were dissatisfied or neutral about an element, three explained their reasons for not being fully satisfied.

- One respondent was dissatisfied with the water pressure from the program-supplied spray valve.[28]
- One respondent was dissatisfied with all program elements because she was ineligible to receive many measures because her store did not meet the minimum weekly number hours of lighting.[29]
- One respondent reported the auditor never followed up with them or provided equipment.[30]

Respondents tended to report that they upgraded all areas they could with program measures. In the two cases in which a respondent reported not replacing any water-saving equipment, they reported the measures did not fit.[31]

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[28] This respondent may have had their spray valve decommissioned by program staff. Of the 1,013 participants that received an item, 18, or 1.8% of the population had something decommissioned by staff. This one case out of 34 represents 2.9% of the sample.

[29] This respondent's business was open 48 hours per week and the program requires lights to be used 60 hours or more week before making LED replacements. This respondent received two faucet aerators.

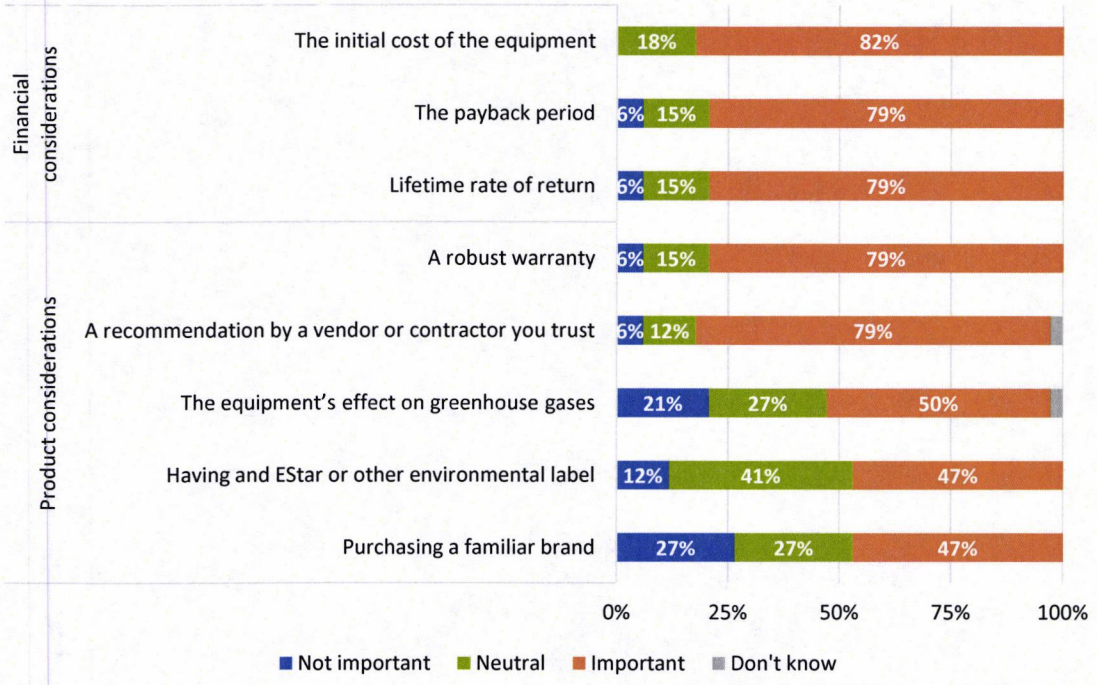
[30] The respondent did receive a promised faucet aerator and vending miser. Program staff verified this during a follow-up call on or about February 5, 2016.

5.4.1.5 Future Upgrades

About two-fifths of respondents (14 of 34) reported plans to make energy saving upgrades within a year after their SB program participation. Most of these respondents (11) said they plan to make a lighting change, three reported plans to make an HVAC upgrade, and one said they plan to install a programmable thermostat[32]. Of the 11 indicating they will make a lighting change, two respondents noted they are making the change to save energy, one of whom is also interested in improving the light quality in his building. The remaining nine did not provide a reason why. Almost two-thirds of those who plan to make an upgrade (9 of 14) said their participation in the SB program influenced this decision. Four respondents stated the program was not influential in their future upgrade decision and one respondent was neutral about the program's influence.

Respondents reported financial considerations, like the cost of equipment and the payback period, were important considerations when making building upgrades. Almost the same percentage of respondents reported product considerations, such as a robust warranty and recommendations from contractors, were important. Far fewer respondents reported environmental attributes of the equipment or labeling was important to them (Figure 5-2).

Figure 5-2: Considerations When Making Building Upgrades (*n* = 34)



[31] Program data shows these respondents did actually receive aerators.

Almost half of respondents (16) said they had known about Avista energy saving programs before they participated in the SB program, with three to four each reporting their source of awareness being a contractor/distributor, word-of-mouth, Avista bill stuffer, or regular contact with an Avista representative and one each citing print advertisements and the Avista website.

Almost all respondents (32) reported they could consider contacting Avista prior to making any building upgrades; the other two did not know whether they would contact Avista.

6 Residential Process Results

6.1 Program Administration

The evaluation team conducted in-depth interviews with Avista program staff, implementation contractors, and Community Action Partners (CAPs) and a survey with contractors to obtain an understanding of how the Avista's residential programs are administered and what challenges these various actors have faced in delivering these programs to the market. The following subsections describe the findings from these interviews and the contractor survey.

Note that the evaluation team organized this section by each program covered in this evaluation. The organization is as follows:

- For the rebate programs, the evaluation team described feedback provided by contractors and Avista's program manager about administration and experience with these programs.
- For the Appliance Recycling, the team reported feedback by JACO, the program implementer, on administration and program challenges.
- For the Simple Steps, Smart Savings, the team reported feedback by Avista's program manager and CLEAResult, the program implementer, on administration, program evolution, and future opportunities.
- For Home Energy Reports or HERs, the team reported feedback by Avista's program manager and Opower, the program implementer, on administration, challenges, and future opportunities.
- The team also reported feedback from CAP agencies – agencies who implement the low-income program for Avista.

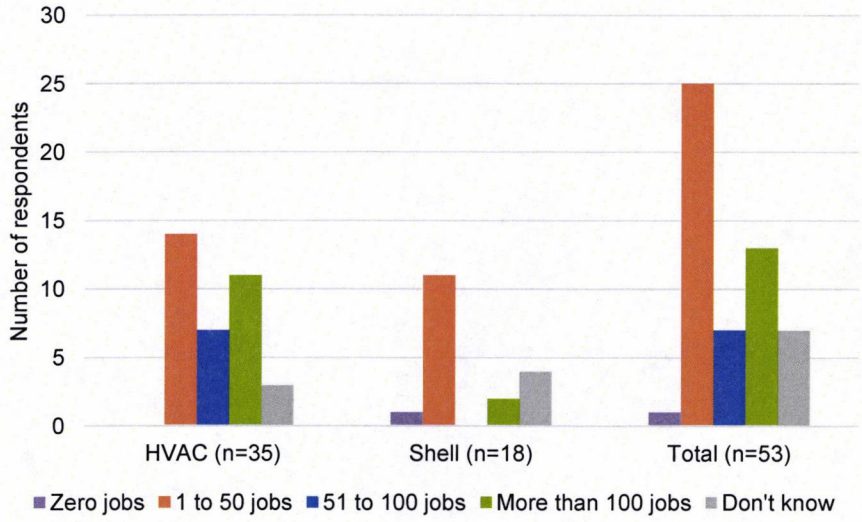
6.1.1 Rebate Programs

This section presents results from the contractor survey and Avista staff interviews related to the rebate programs (i.e., Shell, HVAC, Fuel Efficiency, Water Heat, and ENERGY STAR Homes). Contractors were surveyed about their interactions with Avista program staff, their satisfaction with Avista's residential rebate programs, their sales history and their recommendations for future program opportunities. Avista staff reported on interactions with contractors and future program opportunities.

6.1.1.1 Contractors Interaction with Avista and Program Awareness

Almost all contractors reported doing an Avista rebated project in the last year and about half completed 50 or fewer Avista rebated jobs in 2015. HVAC contractors reported doing more Avista rebated projects than Shell contractors (Figure 6-1).

Figure 6-1: Contractors Number of Avista-Rebated Projects (*n*=53)



Avista projects constituted a considerable portion of all contractors work. HVAC contractors reported, on average, that 42% of their work received Avista incentives and shell contractors reported, on average, that 31% of their work received Avista incentives.

Surveyed contractors reported being aware and familiar with at least some Avista programs. More than three-quarters (42) of residential contractors reported completing projects that received Avista rebates for at least the past five years. Seven more reported completing Avista-projects for four to five years, and four contractors reported completing rebated projects for three years or less. Furthermore, almost all (45 of 46) residential contractors who were able to estimate the amount of Avista-related work they completed in the last year, reported completing at least one rebated project in the last year. Additional analysis shows contractors spend considerable time working on Avista-rebated projects. Almost two-fifths (39%) of contractor completed projects, on average, received Avista rebates.

6.1.1.2 Avista's Interaction with Contractors

Although contractors are familiar with the Avista's rebate programs, there are relatively few interactions between Avista staff and contractors. According to program staff, Avista primarily interacts with contractors when contractors call to request information on behalf of their customers. Avista does not currently offer any formal training for contractors on the rebate programs, and Avista staff only occasionally visit contractor offices to hand out rebate information, the only face-to-face outreach activity reported by program staff. This indicates that there is an opportunity for Avista to engage contractors more with the rebate programs.

6.1.1.3 Contractors' Program Satisfaction

Surveyed contractors reported their satisfaction with nine elements of the program across three different areas: 1) program specific elements including rebates and measures; 2) their interactions with program staff; and 3) program marketing (Figure 6-2).

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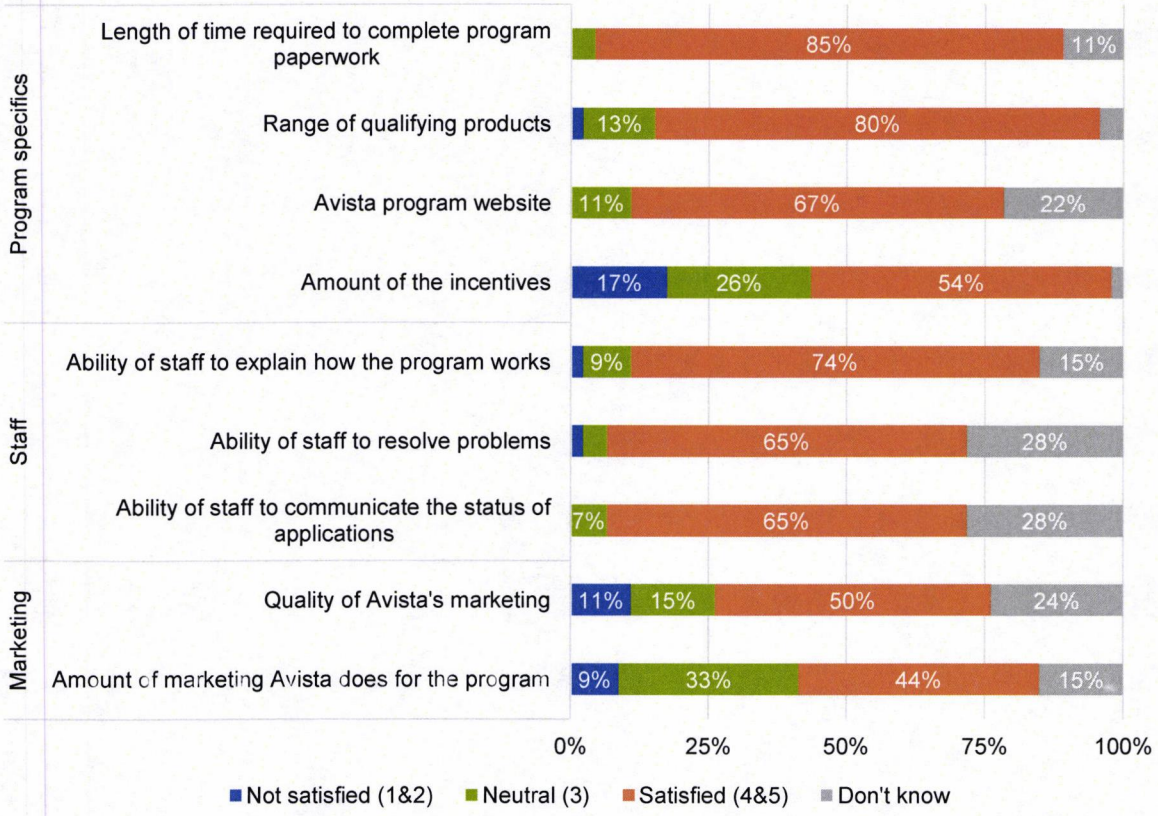
Figure 6-2: Residential Contractors Satisfaction with Program Elements (n=46)*



*n=46 and not 53 because this question was seen only by those who reported a proportion of their projects received an Avista rebate.

Of the three areas investigated, the program-specific elements had the highest proportion of satisfied contractors. Most contractors reported being generally satisfied with three of the four program specific elements included in the survey. The exception was rebate amounts, for which nearly half reported being satisfied, and, unsurprisingly, nearly one-in-six contractors reported being dissatisfied[33]—the single largest area of concern among the nine elements in the survey. Specific mentions of dissatisfaction by respondents included:

- 22 respondents made unspecific comments about their desire for higher rebate levels.
- Seven respondents reported dissatisfaction with the number of rebate eligible products in Idaho (2), the lack of geothermal products (1), and the lack of renewable energy

[33] The evaluation team has seen across many evaluations that contractors often report wanting higher incentives. Higher incentives help them sell more jobs.

product rebates (1). The remaining three implied that the existing range of products was not large enough to attract customers but did not specify products or services.

- Five respondents expressed frustration with the program website finding it "confusing" and hard to find information.
- Two respondents reported dissatisfaction with the amount of time it takes to complete program paperwork.

A majority of contractors also reported being satisfied with the interactions with Avista staff. At the same time, this is also a topic area for which many contractors responded "don't know", suggesting that they either had no opinion on the topic or were unfamiliar or otherwise unwilling to answer the survey questions. However, after excluding those respondents who reported "don't know" about their staff interactions, the results indicate high levels of satisfaction with Avista staff. Ninety-one percent of contractors (48 of 53) were satisfied with staff's ability to resolve problems and communicate application status, and 87% were satisfied with program staff's ability to explain how the program works.

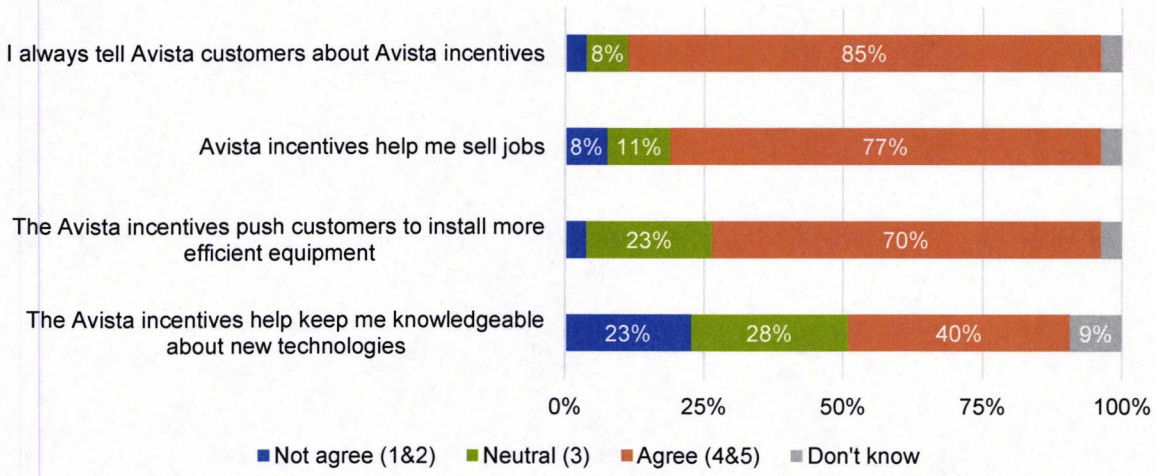
Seven contractors reported some degree of dissatisfaction regarding their interactions with Avista staff. Five reported communication-related difficulties with staff such as delays in getting questions answered or problems identifying and contacting the right staff person. One noted dissatisfaction with the amount of support staff provided in promoting the program and expressed interest in having staff reach out to contractors more and help contractors promote the program. The seventh respondent rated their staff interactions as a three (on a five-point scale) but their comment about staff suggested they were pleased with staff performance.

Of the three satisfaction topic areas investigated, the marketing-related elements had the lowest share of satisfied contractors. A minority of contractors, about one-tenth (11%) indicated they were dissatisfied with the amount of Avista's marketing and nearly one-tenth (9%) noted they were dissatisfied the quality of marketing. However, in their follow-up comments, these five contractors indicated they were largely unaware of Avista's marketing efforts or only saw the materials sporadically. In addition, a notable minority of contractors answered "don't know" to the two marketing-related questions, and a number of respondents answered the question with a '3'—the midpoint on the rating scale. Collectively, these results suggest that contractors may be more unfamiliar with Avista's marketing of the rebate programs more than they are dissatisfied.

6.1.1.4 Contractors' Sales of Efficient Equipment

Rebates are an effective sales tool for contractors. Most contractors agreed that they always tell customers about rebates and that the rebates help them sell more energy efficient equipment and services to their customers, a finding that is supported by Avista staff. However, a relatively low number of contractors agreed that the Avista rebates were helping them stay up-to-date about new technologies (Figure 6-3).

Figure 6-3: How Program Helps Residential Contractors (n=53)



Almost all residential contractors offer customers more than one option when selling products or services. Of the 45 respondents that reported how many options they typically provide customers[34], 89% offered two or more options, and 42% of contractors offered three or more options. The most commonly cited distinguishing characteristic among the options was energy efficiency (62%), followed by price (22%), and then quality (18%). Only a few respondents (4%) reported using non-energy benefits, such as improved comfort, to differentiate the options they presented.

When discussing high-efficiency equipment options with customers, contractors tended to mention lower operating costs (69%), higher quality (67%), and the Avista rebate associated with the equipment (54%) (Figure 6-4).

[34] Eight reported don't know

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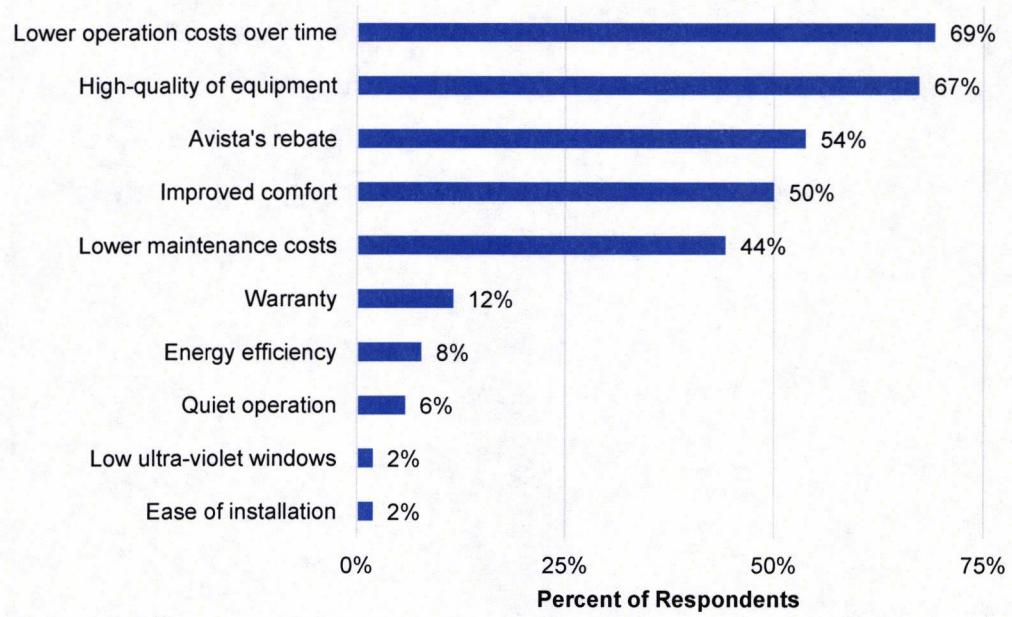
Figure 6-4: Benefits of Efficient Equipment Mentioned During Sales (n=52)*



* One respondent, excluded from this analysis, did not report mentioning any benefits of efficient equipment.

Three-quarters of contractors reported that they prepare all or most of the rebate application (55%) or do the application in concert with the customer (21%). About a quarter stated the customer typically prepares the application.

Six surveyed residential contractors reported discouraging their customers from purchasing highly efficient equipment. They mentioned the following reasons:

- Three respondents mentioned structural barriers that made it difficult to install high efficiency equipment. For example, one respondent reported adding additional venting needed for a high efficiency furnace may add too much to the cost of the project to make it viable.
- Two respondents reported the customer needed the lowest cost option.
- One respondent did not recommend high efficiency equipment when they knew a customer would not benefit from the savings. For example, if a customer was not going to be in the house long enough to realize benefits or savings of efficient equipment.

6.1.1.5 Future Rebate Program Opportunities

Contractors provided suggestions for additional equipment they would like rebated through the programs, and ductless heat pumps and hot water saving measures were the most commonly cited (Table 6-1). All 34 contractors that wanted these pieces of equipment added to the program indicated they thought it would improve or encourage program participation.

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Table 6-1: Contractor Suggestions for Additional Program Measures

	Count	Percent
Ductless heat pump	11	21%
Hot water measures	7	13%
Doors	5	9%
Air conditioning	3	6%
Geothermal	3	6%
Thermostats	1	2%
Furnace	1	2%
Insulated siding	1	2%
CO2 demand control ventilation	1	2%
Non-equipment specific suggestions*	4	9%
TOTAL	**34**	**100%**

* Two respondents wanted the lists in Idaho and Washington to be the same, one wanted gas rebates for people in Kootenai Electric territory, and one wanted unspecified "new" equipment incented.

Avista staff reported investigating several possible future program and/or measure opportunities, showing that Avista staff are preparing for the future and thinking about market changes and innovative opportunities:

- Avista is tracking the heat pump water heater technology to assess whether it is an opportunity in milder climate zones.
- Avista is testing the effectiveness of a smart thermostat pilot to assess whether the pilot can be scaled-up into a program.
- There is some discussion on reconnecting with contractors.
- Avista is considering offering the manufactured home duct sealing program in Idaho and increasing certain rebates: 1) water heater tank rebate (from $20 to $50), 2) tankless water heater rebate (from $130-$180), and 3) high efficiency furnace rebate (from $250 to $300).
- Avista also is planning to install AMI meters in Washington to be able to develop innovative options for delivering programs or different types of smart-grid programs in the future.

6.1.2 Appliance Recycling Program

This section describes feedback from the interview with the implementation contractor, JACO. JACO was interviewed about program administration and challenges.

1.1.1.1 Program Administration and Efficiencies

The Appliance Recycling program launched in 2008, and since then, JACO has worked to improve the program's administrative processes. In 2014 and 2015, while the program was operating, there were no major inefficiencies in these processes. As explained by the JACO

representative, the basic process is as follows: customers call the toll-free number to schedule a pick-up of a refrigerator or freezer, JACO will ask customers whether the unit is working, the size of the unit, and the age of the unit to determine whether the unit qualifies for the program. If the unit is eligible, JACO schedules a pick-up. At the pick-up site, JACO will check whether the unit is working and the age of the unit prior to loading it onto the truck to decommission it. JACO records all the information about the unit and the customer in their database. This database allows JACO to have automated reporting to Avista and an automated dashboard that Avista staff can access to view program progress. Additionally, customers receive an incentive check in about four to six weeks from the pick-up date. The JACO representative reported that this process has been refined and optimized over the years.

The vintage requirement for eligible appliances is 1995 or before, and while on-site JACO also checks the age of the unit. If the unit is determined to not meet the eligibility requirements, JACO still takes the unit to ensure good customer service. This policy has worked well for Avista and JACO in managing customer satisfaction.

1.1.1.2 Program Challenges

Avista's Appliance Recycling program ceased to be cost-effective, which prompted Avista to discontinue the program in June 2015. The JACO representative with whom we spoke provided several suggestions on what Avista could have done to improve program cost-effectiveness: 1) reducing or eliminating the incentive; 2) relying more on in-house marketing such as bill inserts to manage marketing costs; and 3) processing, not destroying, CFC11 foam (destroying is costly).

The JACO representative also noted that the program was not been able to achieve its goals. In the last 3 to 4 years, JACO had a target of recycling about 1,500 units. JACO recycled around 1,100 units in 2014 and expected to recycle close to 1,100 units in 2015. There was not enough budget to commit to the recycling volume Avista wanted to achieve. The JACO representative further noted that Avista committed about 60% of the marketing budget that was needed to achieve the established goals. JACO stated that they optimized this budget by identifying the areas with likely higher participation rates, while ensuring that other areas were still being served. Simple Steps, Smart Savings Midstream Program

This section presents results from the program implementer (CLEAResult) and Avista manager of the Simple Steps, Smart Savings Program. CLEAResult and Avista manager were asked about the program efficiencies, challenges they face during program implementation, and recommendations for future program opportunities.

6.1.2.1 Program Efficiencies

The Simple Steps, Smart Savings program is Bonneville Power Administration's (BPA's) regional promotion designed to increase adoption of various energy efficient technologies, such as compact fluorescent lamps (CFLs), light emitting diode bulbs (LEDs), light fixtures, and energy-saving showerheads. The program includes four delivery components: retail, direct

install, direct mail, and bulk purchase. Avista participates only in the retail component of the program and CLEAResult implements this program for Avista. Avista's staff explained that Avista allocates funds for this program because it is easy to administer and achieves energy savings. Staff explained:

> *Generally, we run this program because of the savings. It is a low touch with the implementer, not a lot of time on our end to implement. Easy to get those savings.*

Avista's staff did not report any communication issues with CLEAResult or BPA related to the program. Likewise, CLEAResult also did not report any communication challenges with Avista. Avista's staff communicates with CLEAResult once a month, when CLEAResult sends Avista a monthly invoice. The invoice includes sales data, savings associated with sold products, and a report noting services rendered by CLEAResult (for example, the number of store visits).[35] Additional communication occurs during contract renewal phase, special product promotions, and when CLEAResult forecasts sales by product category once a year. Avista's communication with BPA is infrequent. There is a monthly conference call with BPA's program manager, who provides program updates and facilities discussion about the program.

Avista's and CLEAResult's experience with Simple Steps, Smart Savings program indicates that the program is delivered efficiently to the market. CLEAResult 1) recruits and negotiates contracts with retailers and/or manufactures; 2) interacts with retailers to communicate program updates and requirements as well as provide point-of-sale (POS) materials; and 3) conducts quality control (QC) checks to verify pricing, POS materials (if present), and products (if on the shelf). Avista conducts QC checks every quarter. The CLEAResult representative reports that nearly all major retailers participate in the program, and the program is helping retailers sell more efficient products. Both Avista staff and the CLEAResult representative note that discounted products are found on store shelves, and the pricing has nearly always been correct.

6.1.2.2 Program Challenges

The challenges identified through the interviews relate to sales data reporting and POS materials. The CLEAResult representative reported that smaller retailers have difficulty providing sales data to CLEAResult because they lack a sophisticated reporting system that larger retailers typically have. Avista's staff noted that different retailers have different rules on what they will display on the shelf. When no POS materials are found on the shelf (it is unclear how often this occurs), customers will not be able to learn of Avista's discount, which can translate into higher free-ridership. Avista staff noted working with CLEAResult to ensure POS materials are displayed in all the stores.

[35] Avista may also receive a document noting any changes to the measures.

6.1.2.3 Program Evolution and Future Opportunities

Although the Simple Steps, Smart Savings program functions well, it has changed recently to meet the needs of BPA and the participating utilities. Specifically, in 2015, BPA no longer pays for non-participating utility savings. Instead, non-participating utility savings are distributed proportionally to participating utilities based on their share of the savings from purchases during that fiscal year.[36] Stated differently, most of the savings from the stores in Avista territory are shared between Avista and other nearby public utilities. For example, if Avista wanted to support a store whose Avista-related sales account for 60% of the store's total qualifying sales, then someone else would have to pay for the remaining 40% of the sales. Before, BPA would step in and pay for the 40% if no other utility wanted to cover the 40%. Now, BPA no longer pays for the 40%. Participating utilities buy savings from Simple Steps, Smart Savings at a cost that covers both their participation savings and a proportionate amount of non-participant savings. In addition, because incentives are no longer fixed, CLEAResult, as explained by their representative, is authorized to reduce the incentives for a product to mitigate the cost of non-participating utility savings in a store.

The CLEAResult representative listed several technologies that Avista should consider if they wanted to add measures to the program: advanced power strips, new lighting controls, water heaters, and ductless heat pumps. The representative also emphasized that Avista should continue with special promotions where higher incentives are promoted for a limited period. Retailers like the limited-term promotions, and these promotions can drive sales. The representative also commented on CFLs. He noted CFLs have not saturated the market and are still an opportunity for utilities because they are cheaper than LEDs. CLEAResult, through their direct install program, has observed three CFLs, on average, in the homes with typically 20-30 sockets.

6.1.3 Home Energy Reports Behavior Program

This section presents results from the program implementer (Opower) and Avista manager of the HER Program. Opower and Avista program staff were asked about the program performance, customization opportunities, challenges they face during program implementation, and recommendations for future program opportunities.

6.1.3.1 Program Administration and Performance

Avista has contracted with Opower to deliver Home Energy Reports (HERs) for about three years, starting in 2013. As part of the agreement, Opower is expected to mail the HERs to participating Avista customers once per month for three months, and then once every two months after that. This is an opt-out program; customers who have been randomly assigned into

36 BPA allocates savings to Avista by using the Regional Sales Allocation Tool (RSAT). RSAT identifies the amount of savings that Avista and other utilities can expect to receive from stores that are in their territories, and that participate in the program.

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the group receiving HERs (the treatment group) and have not opted out participate in this program. Avista provides Opower with contact information for participating customers, and Opower manages the program data and analytics; Avista conducts follow-up quality control checks on the customer data provided to Opower.

Avista staff reported expecting 1% to 3% savings per year from this program, and the program achieved ~2% savings across 2014 and 2015. Further, there is evidence that the Avista promotions described in the HERs have engaged customers. Avista staff reported that there are typically 5-6 reports per year, and two of these reports include an Avista promotion for electric to gas conversions or active rebate programs. Due to issues with the transition from one customer database in 2014 to a new one in 2015, only two reports were sent out in 2015. A prior evaluation documented an increased rate of participation in fuel conversion programs among those in the HER treatment group compared to the control group.[37] The current evaluation showed that HERs plus rebate combination appears to act as the Multiplier Effect[38], amplifying savings, perhaps because HERs are influencing the type and number of rebate programs that customers participate in or additional energy saving behaviors customers are undertaking in their homes (for more detail on this analysis, see Section 7.2).

6.1.3.2 HER Customization

Presently, there is limited ability to customize the HERs, according to Avista staff, but that will change since Opower is re-designing their reports at this time to make them more customizable. The old 2015 reports are customizable, but the new report design, which Opower is working on, will open more space in the report for customized content. An Opower representative noted that the new re-designed reports will incorporate old non-customizable components (some of those elements will be shortened) and allow for more space in the report for utility rebranding and promotional offers. The old or 2015 report design includes four main components:

- Neighbor comparisons (Not customizable; comparing 100 similar-sized homes or homes with similar attributes)
- Personal comparison (Not customizable; compares customer usage to the usage in the same period last year)
- Tips (Customizable; Avista can add tips to the library, populate tips with rebate information, or add a rebate graphic or a website address)
- Optional marketing module (Customizable; Opower can design this module in any way for Avista to promote an offer)

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[37] Cadmus (2014). *Avista 2013 Idaho Electric Impact Evaluation Report* and *Avista 2012-2013 Washington Electric Impact Evaluation Report.*

[38] Multiplier effect occurs when a change in one variable leads to a much larger change in another variable.

6.1.3.3 Program Challenges

The program faced a major delivery challenge when Avista changed its customer billing system in January/February 2015. For about six months after the change, Opower did not receive the necessary customer data from Avista that it needed to mail the HERs. Avista resolved the data issue by June 2015, after which Opower continued sending HERs to participating customers.

Other challenges experienced relate to the eligibility criteria for this program. Initially, Avista wanted to target high energy users. However, Avista did not have enough of these types of customers because Opower needed about 100 homes within 100 miles radius with similar load curves for each target customer to set up a comparison group. Avista also had to exclude homes where usage was seasonal such as vacation homes. Thus, Avista staff decided to use a lower minimum energy usage threshold for this program than they initially expected. The final criterion that was established was 12,000 kWh/year or more in Washington and 8,000 kWh/year or more in Idaho.

6.1.3.4 Future Program Opportunities

The Opower representative provided several suggestions on ways to expand the program:

- Opower suggested adding a monthly email report option for customers. If an email is sent, there are live links that could link to promotions for the rebate programs on Avista's web-based customer portal. In another utility territory, Opower saw a 45% open rate on an email HER and 8% click-through rate. Opower also reported seeing an increase in savings with the email-based HER option.
- The Opower representative also suggested a high bill alert option, in which Opower can send customers high bill alert notices to customers whose bills are projected to be higher than expected. In other territories, Opower saw a 61% open rate for these types of alerts and a click-through rate of 21%.
- A third suggestion relates to Opower's "points and rewards" option. With this option, customers can collect points based on how much energy they save. The points can be redeemed for an Amazon gift card, for example. Opower suggested this could nudge customers to change their behavior.
- A fourth suggestion offered by Opower was to target small and medium business with the reports. Like the consumer facing program, targeting small and medium businesses requires a minimum number of eligible customers to implement this option effectively.
- The last suggestion offered relates to low-income customers. Opower has developed HERs suitable for low-income households which contain tips and suggestion that are appropriate for this group of customers.

Avista staff informed the evaluation team that they are already considering ways to broaden participation in their consumer behavior change programs. For example, Avista staff reported planning installations of AMI meters in Washington in 2017. AMI meters will allow Avista to design many different types of customer engagement and/or smart-grid programs. For example,

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Avista could use the data from these meters to send real-time usage feedback or bill alerts to customers to their mobile devices.

6.1.4 Low-income Program

This section reports the results from interviews with CAP agencies and Avista program staff who work on the low-income program. Overall, the CAPs have an efficient method of delivering services to low income customers, and customers are generally satisfied with the services they received from CAP agencies. Nevertheless, CAPs struggle to serve the low-income market because of limited budgets and high demand for their services.

6.1.4.1 Program Administration

Avista relies on CAP agencies to deliver this program. Figure 6-5 shows the process of how CAP agencies deliver services to low-income customers

Figure 6-5: CAPs Delivery Process to Low-Income Customers

To date, recruiting customers into the low-income program has not been difficult for the CAPs. Most participating low-income customers come from the bill assistance programs. The CAPs also conduct some marketing and outreach, such as bulk mailings, advertising at community fairs, posting flyers in the libraries or food banks, or including flyers in the Avista bills. Larger CAPs, in particular, conduct more marketing than smaller CAPs.

Verifying program eligibility goes beyond documenting the customer's income. Some CAPs will look at the condition of the customer's home; if it is in a bad shape (a roof needs to be replaced, for example), then the CAPs may reject the applicant because the program funding generally cannot cover non-weatherization repairs that exceed the amount of budget allowed for such repairs.[39] Some CAPs also prioritize applicants based on their energy usage or if there are elderly or children in the home. This prioritization enables the CAPs the flexibility to serve customers with bigger electricity bills or other needs.

The pre-installation audit determines whether a customer is eligible for services. The auditors examine energy usage in a home and identify any major repair issues as well as measures that the program could install. For example, auditors at one CAP agency use modeling software on a subset of homes to identify the most cost-effective measures to install, whereas another CAP uses the audit to identify and assess which measures can be installed and subsidized by Avista

[39] Avista allocates only 15% of its funds for non-weatherization measures, typically safety or health measures.

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or other funders. All CAPs use the audit information to assess customer eligibility, as discussed previously.

The CAPs rarely outsource the installation of weatherization measures. Most (three of four) of the interviewed CAPs have their own internal installation crews. One CAP outsources the installation work to various contractors. The CAPs with internal crews may work with other contractors, if there are health and safety issues to remedy or if there is no expertise to install a certain measure. Ordinarily, the CAPs typically approve the installation of the following measures:

- Shell upgrades (Insulation, air-sealing, etc.)
- Duct sealing
- Refrigerator replacements
- Fuel conversions
- Low-cost measures (window plastic or lighting measures)
- Health and safety measures (CO_2 detector installation, asbestos, or rodent abetment, etc.)

Some of these measures (for example, insulation) are priority measures for Avista because they provide more energy savings and are more cost-effective. Priority measures are 100% reimbursed, while non-priority measures are partially reimbursed.

Lastly, every project goes through a quality control (QC) inspection. QC is an important step. It ensures CAPs catch any mistakes in the installation. CAPs use their internal staff for the QC inspection, but they also rely on the city, county, or the state officials to inspect the work for which contractors had to obtain the permits.

6.1.4.2 CAP Agency Interactions with Avista Staff

The CAPs communicate with Avista staff, when needed, and have reported no communication challenges to date. All CAPs except one reported having no invoicing issues as well. (CAPs send monthly invoices or reimbursement form to Avista, which Avista uses to track the progress of this program.) The one CAP contact that noted an invoicing issue stated the invoicing was complex and time-consuming. The representative explained that program staff and not agency's accounting department had to complete the invoicing because of the dollar limitations Avista places on measures.

6.1.4.3 CAP Agency Interactions with Participants

CAPs communicate with low-income customers from start to finish throughout the entire participation process. CAPs also conduct surveys with their customers to gauge customer satisfaction. Generally, customers reported being satisfied with the work done on their home, according to the CAPs. The only negative comment CAPs have received relates to window installations. All of the interviewed CAPs mentioned that participants want window

replacements, but windows are not a cost-effective measure. CAPs will replace a limited number of windows and try to explain to customers that other measures such as insulation or air sealing will yield more energy savings than windows. However, customers have difficulty understanding this concept.

6.1.4.4 Program Challenges

To CAPs, the main challenge is having sufficient funds to more effectively serve the low-income market. Two CAPs noted that there is a bigger need in the market than what they can provide with their services. The same two reported having waiting lists. One CAP noted that the working class segment of the low-income population is underserved.[40] Additionally, all CAPs report some struggle in serving customers because budgets are limited. CAPs would like more funding, and they are always looking to prioritize what they can afford. This is especially the case with funding allocated for safety and health measures. One CAP mentioned constantly fighting over those funds because they cannot weatherize a home without doing at least some repairs. They also reported being cautious not to repair anything for which they will not be reimbursed. Avista staff noted that previously federal funds (especially funding from the American Recovery and Reinvestment Act or ARRA) outweighed utility funds for these programs; today, utility-provided funds outweigh the funds from the federal sources.

CAPs noted a few additional challenges:

- Scheduling an inspection: Two CAPs noted that at times it is difficult to reach customers to schedule an inspection. Inspection is necessary for CAPs to finalize their paperwork and receive reimbursement.
- Difficulty in serving the low-income renter population: One CAP explained that benefits of the weatherization work have to go to the low-income renter only. To ensure this, the program would require landlords to not raise the rent for about 3 years or sell the property for a certain period after work completion. If they sold, then they would have to return some money to CAPs. Landlords are reluctant to sign-off on such requirements.
- Not covering gas measures in Idaho: One CAP has difficulty in identifying enough qualifying customers in Idaho because Idaho funding covers electric measures only.

The main challenge noted by Avista program staff is to make this program cost-effective. Avista staff explained that low-income projects are expensive and Avista tries to make this program as cost-effective as possible. Additionally, Avista has found that over time the savings may be overestimated for some homes that do not use much energy. This also affects cost-effectiveness. Avista might have used a deemed energy savings value for a home when

[40] The working class families often believe they do not qualify for CAP services because they work. Yet, a CAP can consider helping families up to 200% above the federal poverty line with some funding streams. CAPs typically receive funding from: 1) federal agencies (U.S. Department of Energy and U.S. Department of Health and Human Services); 2) regional organizations (Bonneville Power Administration and Avista); and 3) state agencies (Washington Department of Commerce).

estimating savings, but when they examined the annual usage, they have found claimed savings to be more than the usage in certain homes. Avista caps those savings at 20% or 25% of the usage.

6.1.4.5 Suggestions for Improvement

The CAPs provided several suggestions on how to improve the program:

- Avista could help low-income customers offer more in-depth education about saving energy such as offering a class.
- Although acknowledging that only 15% of Avista funds are used for safety or health measures, one CAP suggested Avista could cover more non-weatherization measures such as plumbing leaks.
- Avista could consider funding for newer technologies, especially renewables such as solar.

Avista staff also noted a couple of options they are considering to reach low-income customers, such as working with tribal weatherization agencies to reach additional customers that are typically hard to reach.

6.2 Customer Experience with Rebate Programs

To assess the residential customer experience with Avista's rebate programs during 2014 and 2015, the evaluation team compared survey results between program participants and nonparticipants as well as between customers in Idaho and Washington. Statistically significant differences between the states or years have been highlighted.[41]

This section documents the key findings from participant and nonparticipant surveys as related to Avista's rebate programs (i.e., Shell, HVAC, Fuel Efficiency, Water Heat, and ENERGY STAR Homes). The team also discusses findings related to Appliance Recycling program in this section because Appliance Recycling participants received an incentive for the unit they recycled. Topics covered include awareness and familiarity with Avista rebate programs, motivation and barriers to participation, program experience, and attitudes toward energy use and conservation.

Overall, the survey results suggest that Avista's marketing has been effective in increasing customer awareness of the Avista rebate programs. For participants, in particular, contractors were the main source of awareness of rebate offers and were influential in participants'

[41] Statistical significance was determined based on differences between proportions or means at a 5% level of significance.

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decisions to participate. Both participants and nonparticipants expressed interest in learning more about Avista's programs. Direct mail (bill inserts, for example) were identified as good means of providing this information to customers. Additionally, participants were largely satisfied with the programs, although this varied by program type. Furthermore, program participants did not report any major challenges with the programs, although they expressed a desire for more marketing and outreach about rebate offers and for clarifying program-related information about quality assurance (QA) inspections. Aging or broken equipment and wanting to save energy or money typically motivated participants to make energy efficient upgrades to their homes, whereas the most commonly cited barrier to making efficient upgrades for nonparticipants was the up-front cost of efficient upgrades or repairs. Subsections below document these findings.

6.2.1 Awareness and Familiarity with Avista Programs

The evaluation team reviewed program-related marketing materials and responses from participant and nonparticipant surveys regarding awareness and familiarity with Avista's programs to determine whether customers are learning of Avista's offerings through the marketing channels used by Avista. Survey findings indicate Avista's marketing activities appear to be effective at increasing customer awareness.

The evaluation team's review of Avista's marketing and outreach documents indicates that Avista conducted the following marketing activities in 2014 and 2015:

- Direct mail and bill inserts;
- Print advertisements in newspapers;
- Television advertisements and newscast spots;
- Energy fairs at malls and community centers; and,
- Online digital advertisements.

The source of program awareness among customers is consistent with Avista's marketing activities. Of the 29 nonparticipants who were aware of Avista incentives (41% of the sample), about half (45%) reported learning about Avista's rebate programs through channels Avista used for outreach, such as newsletters, bill inserts, representatives, and events (Figure 6-6). Please note that the nonparticipant sample is representative of the Avista's residential customer population.

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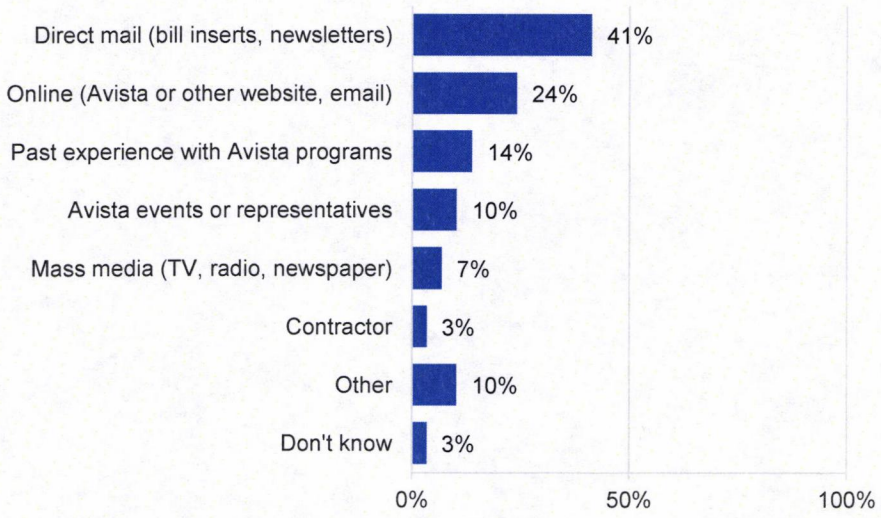
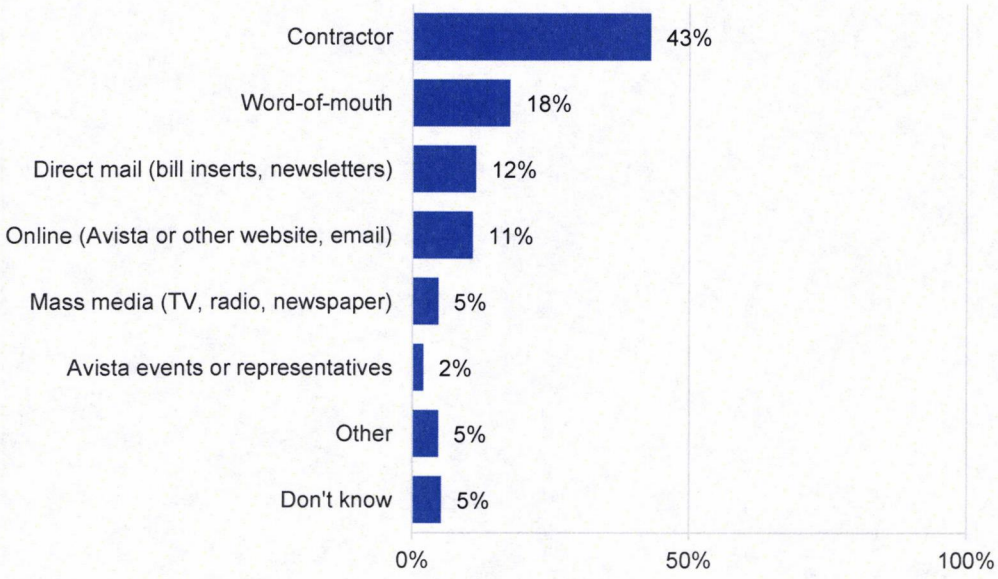
Figure 6-6: Source of Program Awareness (2015 Nonparticipants)



Participants highlighted the importance of contractors in advertising Avista's programs. Contractors were the main source of awareness for participants (Figure 6-7). Nearly half of the surveyed participants indicated they first heard about Avista's programs from contractors, whereas less than one-fifth (14%) reported first learning about the program they participated in via channels Avista used for outreach.[42]

[42] Participants and nonparticipants received slightly different questions. The evaluation team asked participants how participants first heard about the Avista incentive they received (respondents provided a single response). The evaluation team asked nonparticipants who were aware of Avista rebates, how they heard about the rebate (respondents were allowed to provide multiple responses).

Figure 6-7: Source of Program Awareness (2014 and 2015 Participants)



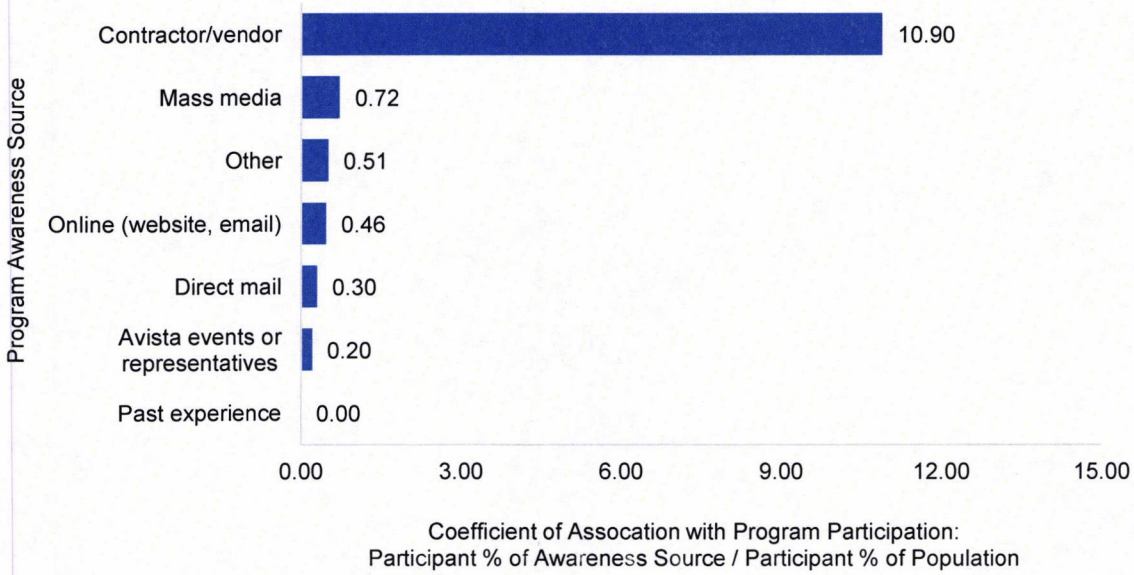
It is difficult to gauge the relative impact of each source of program awareness just by comparing the percentages of participants and nonparticipants that reported a source. A much higher percentage of participants than nonparticipants cited a contractor as a source of program awareness, but what exactly does that tell us about the relative impact of having a contractor make someone aware of the program? How much does that increase the likelihood that someone will become a participant?

The evaluation team developed a coefficient that better illustrates how strong the association was between each source of awareness and program participation. For each awareness source, the coefficient was the ratio between two percentages: 1) the percentage of participants among those who cited a source of program awareness; and 2) the overall percentage of participants in the population. For any given coefficient, the greater the value, the more strongly that source of awareness predicts program participation.

Figure 6-8 shows the coefficient for each source of awareness for program participants. This shows that awareness through a contractor was by far the greatest predictor of program participation.[43] Compared to the overall population, those who learned about the program through a contractor are 11 times more likely to be a participant.

[43] The evaluation team defined program nonparticipants as those who did not participate in 2014 or 2015, but some nonparticipants so defined could have participated in 2013 or earlier. This likely explains why some nonparticipants identified past program experience as their source of program awareness.

Figure 6-8: Relative Association of Residential Participant Awareness with Participant Population



Consistent with the finding that contractors are the single largest source of awareness and information regarding Avista's programs among participants, it is not surprising that fewer than half (46%) of participants reported being familiar with other energy efficiency rebate opportunities from Avista (besides the program in which they had participated).

Awareness of other Avista energy efficiency rebate opportunities was highest among Water Heat and Fuel Efficiency program participants and lowest among ENERGY STAR Homes participants (Figure 6-9), which further suggests there may be some knowledge "gaps" among the various contractors supporting Avista's programs regarding their awareness and familiarity with Avista's full range of program offerings.

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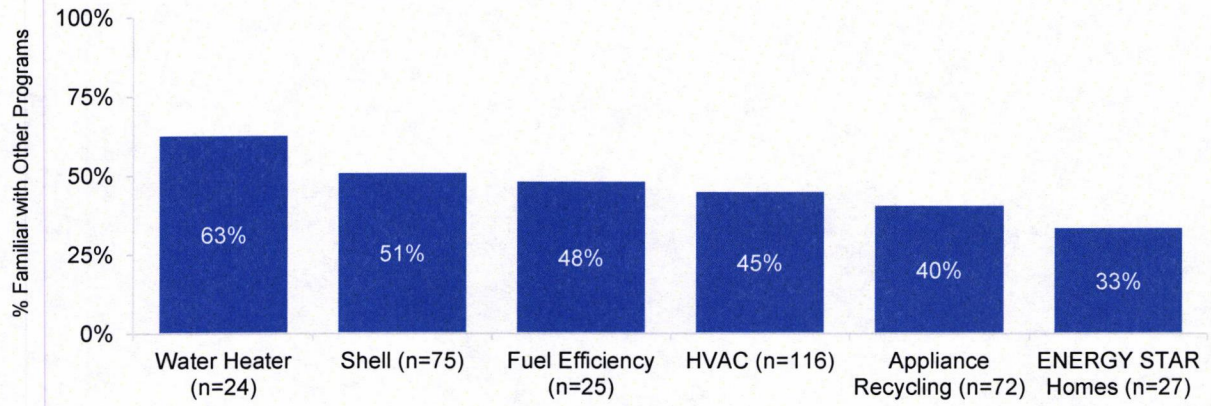
Figure 6-9: Percentage of 2014 and 2015 Participants Familiar with Avista Rebates for Other Programs



Among the twenty-nine nonparticipants (41% of the sample) that reported being familiar with Avista incentives, between one-third and one-half reported being familiar with the Shell, HVAC, Appliance Recycling, and Fuel Efficiency incentives (Table 6-2). Two surveyed nonparticipants reported being familiar with CFL and LED store discounts offered by Avista. None reported being familiar with Water Heater or ENERGY STAR Homes incentives programs.

Table 6-2: Nonparticipant Awareness of Avista Incentives, (n=29; Multiple Responses Allowed)

Incentives Familiar With	Count	Percent
Shell (insulation and windows)	13	45%
HVAC	11	38%
Appliance Recycling	10	35%
Fuel Efficiency (electric to gas furnace or water heater conversions)	10	35%
CFL and LED store discounts	2	7%
Other	4	14%
Don't know	1	3%

Interest in receiving additional information regarding Avista's energy efficiency offerings is high among both participants and nonparticipants. About three-quarters (77%) of participants reported being interested in receiving energy-saving information from Avista (Table 6-3). Although still a majority, significantly fewer nonparticipants reported wanting information from Avista. Information on energy efficiency programs and energy savings opportunities were the most common types of information requested by respondents. However, significantly fewer nonparticipants reported that they would like information on energy efficiency programs compared to participants.

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Table 6-3: Additional Energy Saving Information Requested (2014 and 2015 Participants and 2015 Nonparticipants; Multiple Responses Allowed)

Information regarding…	Participants (n=339)		Nonparticipants (n=70)	
	Count	Percent	Count	Percent
Energy efficiency programs	226	67%	37	53%[a]
Energy savings opportunities	222	65%	41	59%
Workshops or events on energy efficiency	103	30%	22	31%
Nothing	76	22%	28	40%
Don't know	1	0%	0	0%

[a] Differences between participants and nonparticipants are statistically significant (Chi-square Test at p<0.05).

Participants and nonparticipants indicated they wanted to receive additional information from Avista regarding energy efficiency by mail – which suggests that direct mail approaches are good avenues to market programs. Both participants and nonparticipants who reported wanting additional information from Avista indicated they would prefer to receive the information by mail (78% and 90%, respectively) – primarily via a bill insert (Table 6-4). The evaluation team found that nearly three-quarters of participants and nonparticipants reported receiving their bills in the mail (71% and 70%, respectively).

Table 6-4: Preferred Method of Receiving Information from Avista (2014 and 2015 Participants and 2015 Nonparticipants; Multiple Responses Allowed)

How first heard	Participants (n=262)		Nonparticipants (n=42)	
	Count	Percent	Count	Percent
By US mail	204	78%	38	90%
By US mail via bill insert	162	62%	26	62%
By US mail separate from bill insert	96	37%	19	45%
By e-mail	81	31%	14	33%
Avista website	28	11%	2	5%
Other	17	6%	2	5%

Nonparticipant survey findings, which are representative of the overall residential customer base, also suggested Avista's marketing efforts were having an influence on customers. Of the 25 nonparticipants who reported making efficient upgrades to their home, over half (14 respondents) reported that Avista marketing was "very influential" in their selection of the equipment (a rating of 4 or 5 on a five-point scale, from "no influence" to "great influence").

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6.2.2 Motivation and Barriers to Participation

Participants reported increased home comfort, saving energy, and saving money as the top three motivations for participating in a rebate program, and they reported ease of participation as a close fourth (Table 6-5).[44] The evaluation team found that significantly more participants in Idaho reported being motivated by a recommendation from a contractor, builder, or vendor compared to Washington participants (70% in ID; 55% in WA; Chi-square Tests at $p<0.05$).

Table 6-5: Motivations for Participating in a Rebate Program (2014 and 2015 Participants; Multiple Responses Allowed)

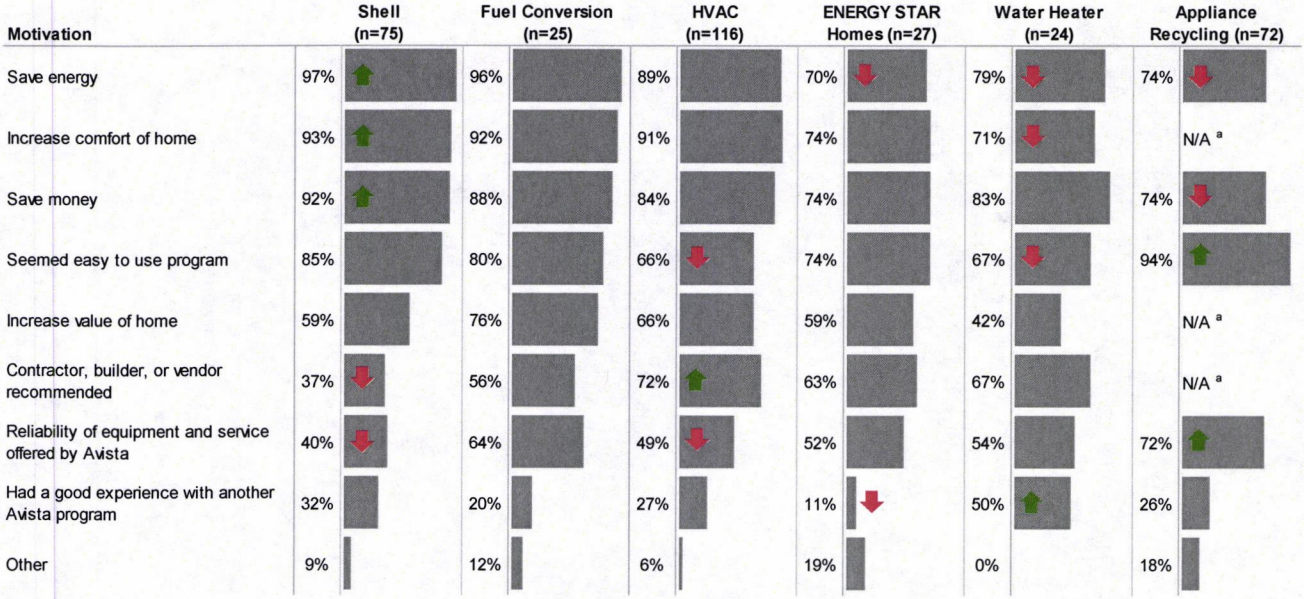
Motivation	Count	Percent
Increase comfort of home *(n=267)*	235	88%
Save energy *(n=339)*	291	86%
Save money *(n=339)*	281	83%
Seemed easy to use program *(n=339)*	265	78%
Increase value of home *(n=267)*	166	62%
Reliability of equipment and service offered by Avista *(n=305)*	182	60%
Contractor, builder, or vendor recommended *(n=267)*	159	60%
Had a good experience with another Avista program *(n=339)*	94	28%
Other *(n=339)*	35	10%

Avista leverages the contractor channel to promote rebate programs. The overall participation in the rebate programs has increased by 43% from 2014 to 2015 (see Section Table 7-1). This increase in participation may indicate that contractors have been engaged in promotion of Avista's rebates more so in 2015 than 2014. There is some evidence of this supposition. Compared to 2014, there was an increase in the proportion of participants reporting being motivated by a recommendation from a contractor, builder, or vendor to participate in a rebate program in 2015 (53%, up from 40% in 2014).

Figure 6-10 shows that participant motivations for completing efficient upgrades to their home vary by program type. For example, significantly more Shell participants reported participating in the program to save energy compared to ENERYG STAR Homes, Water Heater, and Appliance Recycling participants (Z-Test of Proportions at $p<0.05$). These differences suggest that customers are participating in the various programs for different reasons, which speaks to the importance of tailoring the marketing messages for each program.

[44] This includes all rebate programs, including Appliance Recycling. The evaluation team included Appliance Recycling participants because they also received a rebate for recycling their refrigerators or freezers.

Figure 6-10: Motivations for Participating in a Rebate Program, by Program (2014 and 2015 Participants; Multiple Responses Allowed) [a]



[a] Arrows in figure represent significant differences between program types. Green, upward arrows indicate the value is significantly higher than the values with red, downward arrows (Z-Test of Proportions at $p<0.05$).
[b] Appliance Recycling program participants were not provided with this option.

Twenty-five (36% of the sample) of nonparticipants reported completing an upgrade at their home in the past two years. Nonparticipants reported completing a variety of upgrades, including windows (eight mentions), insulation (seven mentions), and lighting upgrades (five mentions). Eighteen (82%) of nonparticipants who completed an upgrade reported that at least one of the upgrades they have made in the past two years were installations of equipment labeled as ENERGY STAR certified or otherwise being highly energy efficient.

Aging equipment was the primary motivation for replacing or upgrading equipment reported by nonparticipants, followed by broken equipment (10 and 5 mentions, respectively). A minority (four mentions) also noted wanting to save energy as a reason for completing efficient upgrades to their home. Please note that the evaluation team asked nonparticipants about their reasons for making upgrades to their home, whereas participants reported only about their motivations for participating in a rebate program.

About one-quarter (24%) of nonparticipants reported they planned to make an efficient upgrade to their home within the next two years. Among those respondents planning an upgrade, window replacement was most commonly mentioned (eight mentions), followed by HVAC equipment (four mentions) and lighting upgrades (three mentions). (Table 6-6).

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Table 6-6: Future Upgrades Planned (2015 Nonparticipants; n=70; Multiple Responses Allowed)

Upgrades Planned	Count	Percent
Windows	8	11%
HVAC	4	6%
Lighting	3	4%
Insulation	2	3%
Refrigerator or freezer recycling	2	3%
Water heater	1	1%
Other	5	7%
Nothing	53	76%

About half (54%) of nonparticipants, reported facing at least one barrier to saving energy in their home. The most frequently cited barrier was the up-front cost of efficient equipment or repairs (Table 6-7), which indicates an importance of offering an incentive to customers for home improvement projects. Nonparticipants also reported that living in a rental property prohibits them from making improvements to their home. Further, demographic analysis revealed that nonparticipants were significantly more likely to report being renters than participants (27% vs. 3%, respectively; Chi-square Test at $p<0.05$).

Table 6-7: Barriers to Making Energy Efficiency Improvements (2015 Nonparticipants; n=38; Multiple Responses Allowed)

Barriers	Count	Percent
Up-front cost of equipment or repairs	16	42%
Renter - unable to make improvements	9	24%
Unspecific issues related to older/inefficient home	4	11%
Other occupants of home / Occupant behavior	3	8%
Lack of time	2	5%
Payback period of equipment or repairs	2	5%
Other	6	16%

6.2.3 Program Experience

The following section provides a summary of participant survey findings related to satisfaction with program elements, satisfaction with contractor interactions, and the clarity of program information.

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6.2.3.1 Program Satisfaction

More than four-fifths (84%) of program participants reported their overall satisfaction with their Avista rebate program experience as being either "very" or "completely" satisfied (Figure 6-11). The evaluation team found that overall program satisfaction has decreased for Washington participants from 2014 to 2015 (80% "very" or "completely" satisfied, down from 89% in 2014; marginally significant Chi-square Tests at $p<0.1$).

Additionally, participants reported the lowest satisfaction with the rebate amount they received (Figure 6-11). Similarly, contractors reported the lowest satisfaction with the amount of incentives provided by Avista when they rated various elements of Avista's rebate programs (see Section 6.1.1.2).[45]

Figure 6-11: Satisfaction with Program Elements (2014 and 2015 Participants)

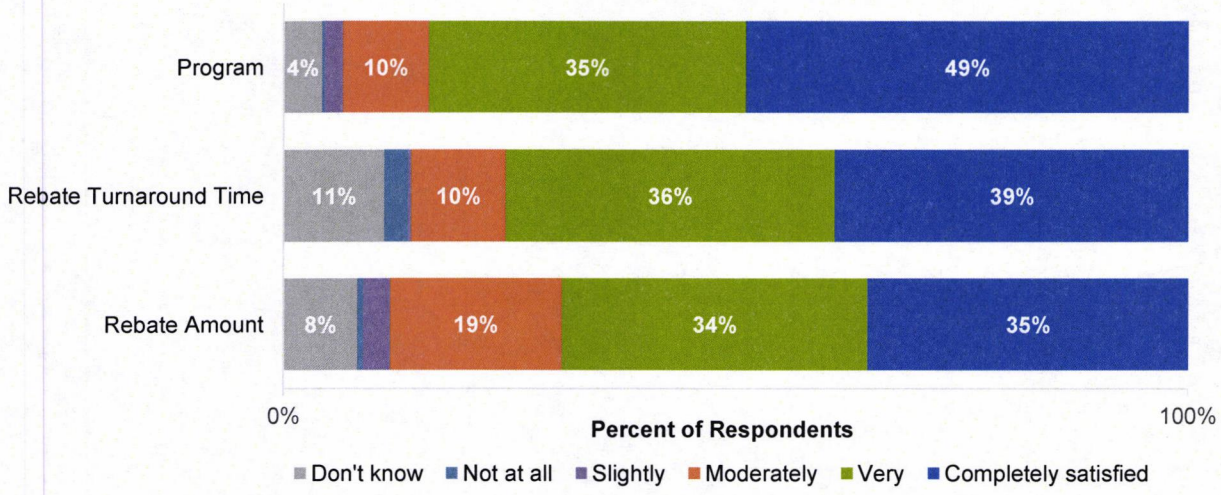
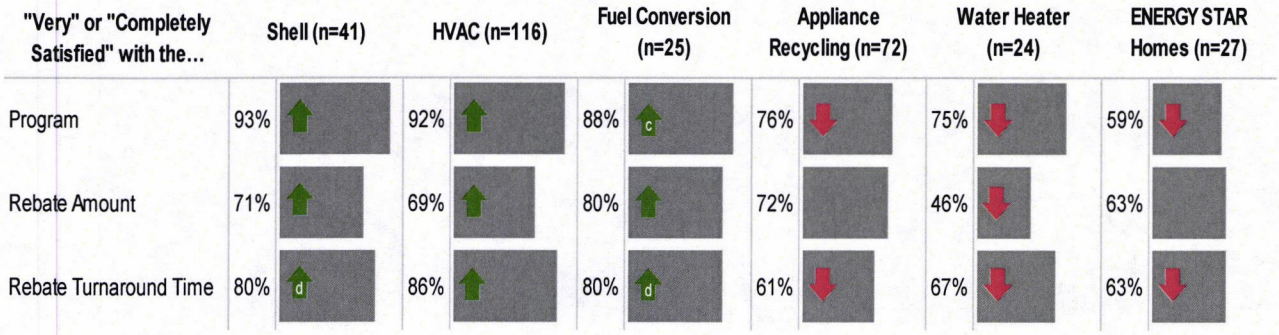


Figure 6-12 shows that Shell, HVAC, and Fuel Conversion participants are generally more satisfied with their program experience than Appliance Recycling, Water Heater, and ENERGY STAR Homes participants. For example, Shell, HVAC, and Fuel Conversion participants reported significantly higher satisfaction ratings compared to Water Heater participants (Z-Test of Proportions at $p<0.05$).

[45] The evaluation team has seen across many evaluations that program participants and contractors often report wanting higher incentives. Higher incentives allow participants to offset more of the incremental cost and contractors to sell more jobs.

Figure 6-12: Satisfaction Rating, by Program (2014 and 2015 Participants) [a, b]



[a] Percent reporting "Very" or "Completely Satisfied" on a 5-pt. scale (not at all, slightly, moderately, very, and completely satisfied).

[b] Arrows in the figure represent significant differences between program types. Green, upward arrows indicate the value is significantly higher than the values with red, downward arrows (Z-Test of Proportions at p<0.05).

[c] Only significantly higher than Water Heating and ENERGY STAR Homes participants (Z-Test of Proportions at p<0.05).

[d] Only significantly higher than Appliance Recycling participants (Z-Test of Proportions at p<0.05).

Based on interviews with JACO staff, Avista's appliance recycling implementation contractor, most complaints regarding the Appliance Recycling program relate to appliance pick-up difficulties during inclement weather, delays in the customer verification process, and incentive check delays. The evaluation team had no additional information on complaints by participants in the Water Heater or ENERGY STAR Homes programs, two other groups that exhibited lower satisfaction.

One hundred respondents offered suggestions for improving the Avista rebate programs (Table 6-8).[46] About two-fifths (39%) of these respondents felt that more or better program information through marketing and program materials would improve the programs. However, respondents did not provide more specifics regarding the types of materials or messaging that they would like to see.

[46] One-hundred and fifty-seven respondents said "Do not know" when asked to provide suggestions for improving the rebate program.

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Table 6-8: Suggestions for Improving the Rebate Program (2014 and 2015 Participants; n=100; Multiple Responses Allowed) [a]

Suggestion	Count	Percent
More program outreach and advertising	37	37%
Higher rebate	18	18%
Communication improvements/Confusion with program requirements	11	11%
Process is too slow - increase speed	11	11%
Improvements to application process	10	10%
Offer additional incentives/Financial assistance	6	6%
Other	12	12%

[a] Includes all 2014 and 2015 respondents saying they have suggestions on how to improve the rebate program; 157 said they did not know and 48 said the program is working well with no need for improvement. Thirty-four participants in the direct install duct-sealing program were excluded as they did not receive a rebate.

6.2.3.2 Participant's Satisfaction with Contractors

Nearly all (91%) of the surveyed Fuel Efficiency, HVAC, Shell, and Water Heater participants used a contractor to install the measure. About four-fifths (83%) of Water Heater participants reported using a contractor, compared to 89% of Shell, 92% of HVAC, and all of Fuel Efficiency program participants. The majority (88%) of these participants reported being satisfied with their contractors (rating of "Very" or "Completely Satisfied" on a 5-pt. scale). The evaluation team found participation satisfaction with their contractor increased significantly between 2014 and 2015 (92%, up from 83% in 2014; Chi-square Tests at $p<0.05$). Almost all (93%) of those who used a contractor reported they would recommend their contractor to other people.

6.2.3.3 Clarity of the Program Information

A majority of participants reported that program-related information (e.g., website or rebate form) was clear on how to apply for a rebate, which equipment qualified for a rebate, expected energy savings of program eligible equipment, and who to contact if any issues arose (Figure 6-13). Significantly fewer Washington participants reported the expected energy savings claims were clear in program collateral compared to Idaho participants (59% vs. 72%, respectively; Chi-square Tests at $p<0.05$), although it is unclear whether the program materials, in fact, differ by state. Figure 6-13 also shows that for Shell program participants, the program materials were less clear about the quality assurance (QA) process. Additionally, the evaluation team found that the clarity of information regarding which equipment or items qualified for rebates was less clear for Shell participants than for other program participants (70%, compared to 90% for Water Heater, 83% for ENERGY STAR Homes and Fuel Efficiency, and 80% for HVAC and Appliance Recycling participants; Chi-square Tests at $p<0.05$).

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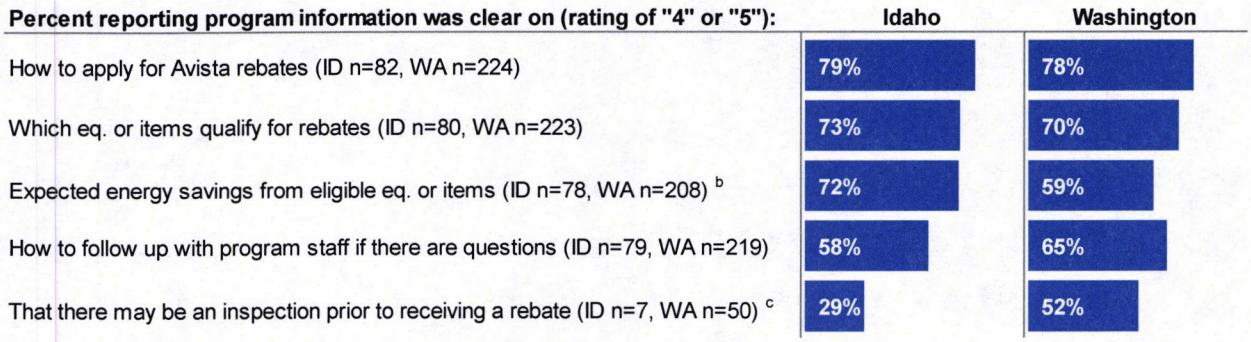
Figure 6-13: Clarity of the Program Information by State across 2014 and 2015 (2014 and 2015 Participants) [a]



[a] Percent saying "4" or "5" on a 5-pt scale where 1 meant "the information was not at all clear" 5 meant "the information was very clear." The evaluation team excluded "not applicable" from this analysis.
[b] Difference between Idaho and Washington statistical significant (Chi-square Tests at $p<0.05$).
[c] Only Shell participants were asked this question.

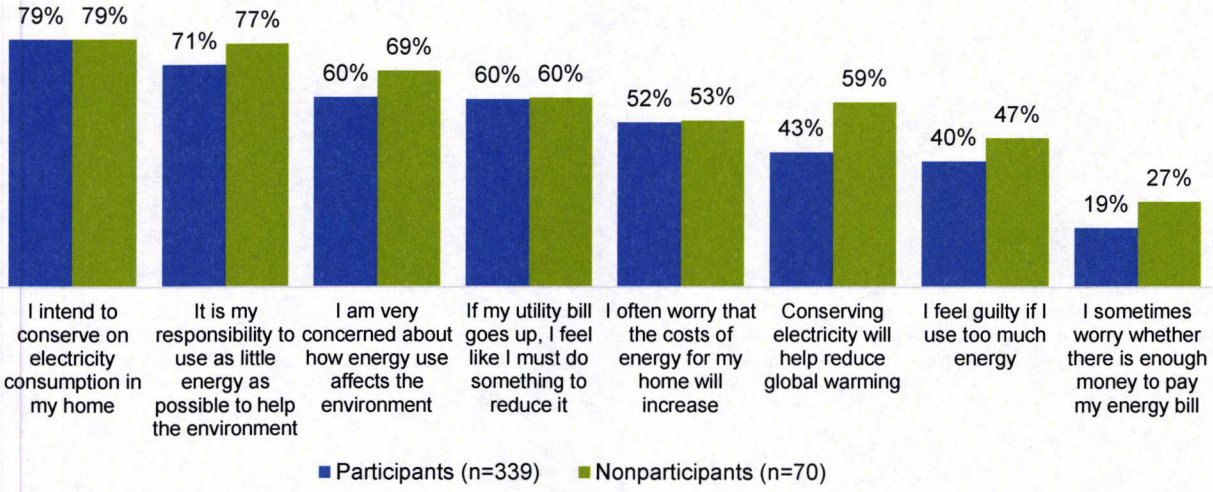
6.2.4 Attitudes toward Energy Use and Conservation

Participants and nonparticipants rated their agreement with eight statements designed to measure respondents' attitudes towards adopting energy efficient behaviors. The statements asked about intention to conserve, concern about environment or cost of energy, among others. The evaluation team relied on the previous research, specifically the Awareness-Knowledge-Attitude-Behavior (akAB) model of change, to develop these statements. The akAB model is grounded in years of social science research on how individuals make energy conservation and efficiency choices, as well as "green" choices more generally. It includes five stages of energy-efficient behavior change: awareness/knowledge, concern, ascription of responsibility, intention to conserve, and maintaining the behavior.[47] The participant and nonparticipant surveys only included statements on intention to conserve, ascription of responsibility, and concern.

Overall, respondents reported highest agreement (providing a 4 or 5 on a scale 1 "not at all agree" to 5 "completely agree") that they intend to conserve electricity in their home and that it is their responsibility to use less energy to help the environment (Figure 6-14). Although participants and nonparticipants differed in responses on several metrics, differences were not statistically significant, suggesting that participants do not differ from nonparticipants in relation to how they think about the energy saving concepts noted in the figure below.

[47] For more information, see the following study: PG&E and SCE. 2011-2012 General Households Population Study in California, *http://www.calmac.org/publications/GPS_Report_08302012_FINALES.pdf*

Figure 6-14: Agreement with Eight Statements Associated with Energy Usage and Conservation [a]



[a] Respondents rated their agreement with each statement on a five-point scale with 1 being "not at all agree" and 5 being "completely agree."

6.3 Customer Experience with Simple Steps, Smart Savings Program

This section provides findings regarding customers' experience with the Simple Steps, Smart Savings midstream program. Simple Steps, Smart Savings is BPA's regional promotion designed to increase adoption of various energy efficient products, including CFLs, LEDs, light fixtures, and energy-saving showerheads. The program discounts the following measures at retail locations: standard and specialty CFLs, LED bulbs and fixtures, and low-flow showerheads.

The evaluation team asked both rebate program participants and nonparticipants a series of questions to determine: 1) the incidence rate of purchasing a CFL, LED, or a showerhead; 2) the usefulness of in store point-of-purchase (POP) materials to buyers; and 3) their awareness of the Simple Steps, Smart Savings program. By design, the nonparticipant sample is more representative of customers in Avista's territory than the participant sample and thus provides a more accurate representation of customer experience with the Simple Steps, Smart Savings program. The participant sample consists only of a subset of Avista's customers (those who participated in Avista's rebate programs), whereas the nonparticipant sample was drawn from the entire Avista customer database and was designed to be representative of the state and

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urban/rural population.[48] To provide results that are more representative of Avista's customer population, the evaluation team only presents findings from the nonparticipant survey in this section.

Most (71%) nonparticipants reported purchasing at least one product referenced above in 2015. Among respondents who purchased CFLs, LEDs, or showerheads, most (78%) reported purchasing standard CFL bulbs, followed by LED fixtures (34%), and low-flow shower heads (26%; Table 6-9).

Table 6-9: Purchases of CFLs, LEDs, or Showerheads in 2015 (2015 Nonparticipants; n=50; Multiple Response Allowed) [a]

Measure	Count	Percent	Average number purchased
Standard CFL bulbs	39	78%	12
LED fixtures	17	34%	6
Low-flow showerheads	13	26%	1
Specialty CFL bulbs	7	14%	2

[a] The evaluation team did not ask nonparticipants about LED bulbs because they were not added to the Simple Steps, Smart Savings program until July of 2015.

Figure 6-15 shows that a large majority of nonparticipants reported they were easily able to find CFLs, LEDs, and low-flow showerheads at the stores where they commonly buy these products (providing a rating of 4 or 5 on a five-point scale with 1 being "not at all easy" and 5 being "very easy").

[48] Participants are more likely to be urban dwellers than nonparticipants. Additionally, participants were more likely to be homeowners and have higher incomes.

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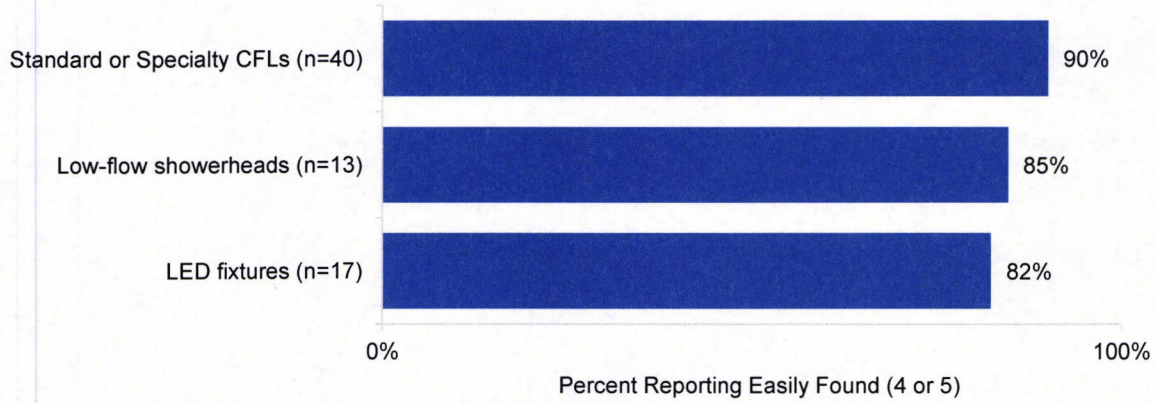
Figure 6-15: Ease of Finding Lighting and Low-flow Showerheads (2015 Nonparticipants)[a]



[a] Respondents rated the ease of finding the products on a five-point scale with 1 being "not at all easy" and 5 being "very easy."

Findings also suggest that some of the products purchased by nonparticipants were program-discounted measures. Nonparticipants who purchased CLFs, LED fixtures, or showerheads reported whether they recalled seeing the Simple Steps, Smart Savings point-of-purchase (POP) materials where they were shopping for these products. About one-quarter (12 of 50) reported seeing the POP materials, of these, five reported recalling the product they purchased was part of the Simple Steps, Smart Savings program (i.e., the product was discounted). In comparison, more than two-fifths (44%) of rebate participants who purchased a CFL, LED, or showerhead reported recalling the product they purchased was part of the Simple Steps, Smart Savings program. This finding suggests that rebate participants may pay greater attention to POP materials (either due to greater brand awareness or they are more likely to be looking for discounts) when making these purchases than the general customer population.

6.4 Customer Experience with the Behavior Program

The evaluation team asked participants and nonparticipants a series of questions regarding the Home Energy Reports they receive from Opower to determine their usefulness and impact. The evaluation team found that there is some confusion among respondents as to whether they received a HER. Slightly less than one-third of participants and nonparticipants reported receiving a HER from Avista in 2014 (28% and 30%, respectively). However, after reviewing program data, the evaluation team determined that fewer than one in ten (9% of participants and 6% of nonparticipants) respondents surveyed actually received a HER from Avista in 2014 or 2015.[49] It is possible that the respondents who incorrectly reported receiving a HER were

[49] To determine who received a HER, the evaluation team matched participant and nonparticipant IDs with those in the HER treatment group.

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referring to the energy saving information they received through their monthly online or paper bill rather than the HER.

The overall recall rate among those who the evaluation team confirmed received a HER (n=29) was high and consistent with findings from other data sources. About four-fifths of the 36 participants and nonparticipants who received a HER, correctly reported receiving a HER (78% and 100%, respectively). The remaining respondents reported either they did not know if they received (four mentions) or that they did not receive (two mentions) a HER. The recall rate is consistent with a 2014 study conducted by MDC Research, which found about four-fifths (78% unaided and 81% aided) of Avista customers who received a HER recalled receiving it.[50]

There is evidence that HERs are engaging customers to save energy in their homes. Among those 29 participants and nonparticipants who reported and who actually received a HER, all but two reported they "usually" or "always" read the report. Of the remaining respondents, one reported reading the HER once or twice and one reported never reading the HER. Additionally, about two-thirds (64%) of respondents who actually received and read their HER reported taking action to save energy in response to the reports. Participants reported taking various energy-saving actions, including: making unspecific energy saving modifications to their home, adjusting how or when they use energy (eight mentions each), purchasing energy saving products and receiving Avista rebates (six mentions), purchasing energy saving products and not receiving Avista rebates, and looking for additional information on how to save energy (two mentions each).

Participants and nonparticipants who correctly reported receiving and who read their HERs reported varying levels of satisfaction and usefulness of the reports. Of the 28 participants who confirmed they received and read their HERs, over half (58%) reported they were "very" or "completely" satisfied with the report (Figure 6-16). Similarly, about two-fifths (40%) reported finding the HER to be "very" or "completely" useful in helping them to better understand their home's energy use.

[50] MDC Research. Avista Energy Usage Communications Research Presentation. June 2014.

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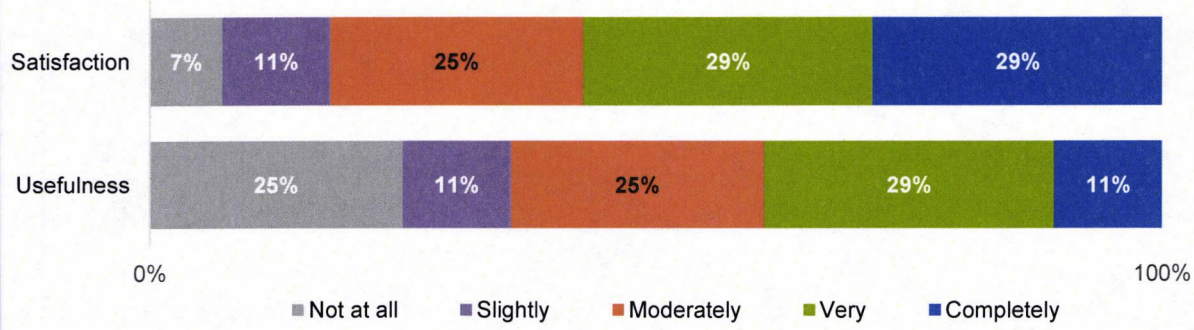
Figure 6-16: Usefulness and Satisfaction with HER (2014 and 2015 Participants and 2015 Nonparticipants; n=28) [a]



[a] Note: this analysis excludes one respondent who reported never reading the HER the received.

Twelve respondents provided additional comments regarding the HERs they received. Comments included: being concerned with the accuracy of the HER (four mentions), wanting more information and tips (four mentions), not understanding the comparisons between their home's energy use and others (three mentions), and finding the HER interesting and easy to understand (one mention).

6.5 Freeridership and Spillover

This section summarizes results about freeridership and spillover, two key aspects of energy efficiency programs. Freeridership represents an estimate of the energy savings that the program participants would have achieved without the program's assistance, and spillover is what additional energy saving actions occurred outside the program but as a result of program influence. This section begins with a discussion of freeridership and concludes with a discussion of spillover. For a discussion of the methods used to calculate freeridership and spillover values, see the 2014-2015 impact report discussion about net-to-gross calculations. Additionally, the impact report covers how freeridership and spillover rates effect savings.

6.5.1 Freeridership

The evaluation team examined freeridership for five program types: appliances, HVAC and Water Heat, Fuel Conversion, Weatherization and Shell, and ENERGY STAR homes. To see how freeridership changed over time, the evaluation team plotted freeridership results for PY2014 and PY2015 next to results from the previous evaluation dating back as far as 2010. Fuel conversion freeridership scores were available back to 2012 and there were no reported freeridership values for ENERGY STAR Homes in the previous evaluation.

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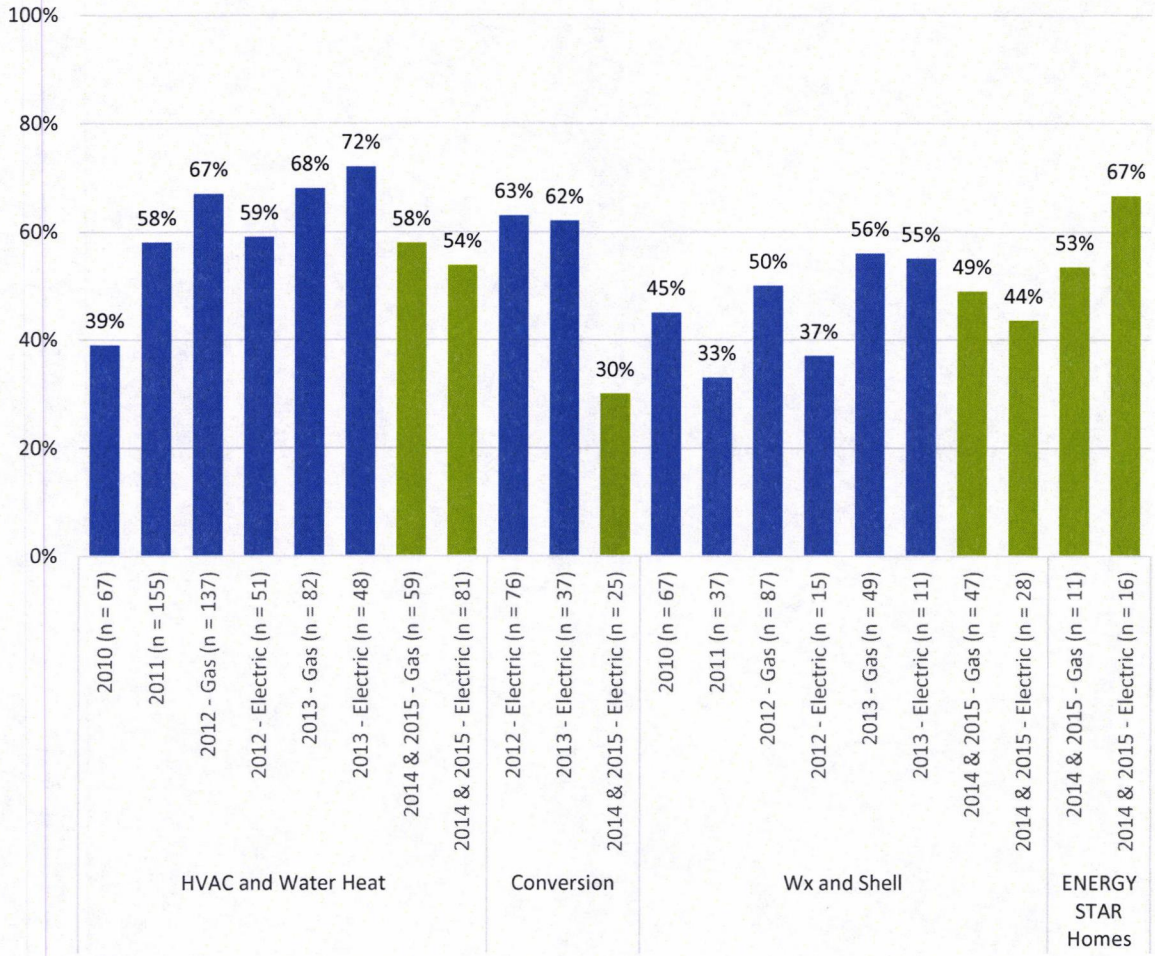
Figure 6-17 shows freeridership values for active programs[51] and shows, on average, slightly lower rates for HVAC/Water Heat and Weatherization/Shell measures and a considerably lower freeridership rate for Fuel Conversion, compared to the 2013 evaluation.

Figure 6-17: Freeridership Over Time*



*Orange bars reflect values calculated by the evaluation team. Blue bars are values reported in previous process evaluation (Avista 2012-2013 Process Evaluation Report, May 15, 2014, prepared by Cadmus Inc.)

The previous evaluation attributed the general upward trend in freeridership, seen from 2010 to 2013 across HVAC/Water Heat and Weatherization/Shell, to the influence the program is having on the market. The evaluation team agrees that the program could have influenced the market

[51] Appliance recycling is not included here because it was discontinued in 2015.

and that influence could have affected freeridership rates. Some of the differences seen in freeridership scores between 2014 & 2015 values and prior analyses may be a result of different methodologies used to calculate freeridership.

The Fuel Conversion program values noticeably differ from the other programs, however. The evaluation team hypothesizes that the sharp drop in freeridership from 62% to 30% for the Fuel Conversion program from 2013 to 2014 & 2015 may be a result of the distribution of low-income participants in each program year. If in 2014 & 2015 there was a high participation rate among low-income customers, that may drive freeridership values lower as low-income participants are likely to be low free-riders. Conversely, if there were relatively few low-income participants in 2012 and 2013 that could increase freeridership values.

Another hypothesis related to the decline in freeridership in the Fuel Conversion program relates to price of natural gas over the last six years. The decline of natural gas prices from 2008 to 2015[52] may have driven participants to convert to gas during the years the prices decreased most notably, 2009 – 2013. As the price of gas plateaued in 2014 to 2015, customers may feel less inclined to convert to gas, thus lowering freeridership.

6.5.2 Participant Spillover

Participant spillover occurs when program participants elect to conduct energy saving activities outside of the program as a result of program influence. Because the actions took place outside of the program, the program has no mechanism to capture these actions other than during process surveys. The analysis below shows that 3% of weatherization/shell participants and 1% of HVAC/Water Heat participants reported they took a spillover action (Table 6-10). Other program participants reported no spillover.

Table 6-10: Number of Participants Reporting a Spillover Action

Program	Total Participants in Sample	Participants Who Did Spillover Project	Percent of Participants Who Did Spillover Project
Weatherization and Shell	75	2	3%
HVAC and Water Heat	140	2	1%
All other programs[53]	52	0	0%
TOTAL	**267**	**4**	**1%**

For an analysis and discussion of what effect these actions had on savings, see the impact report.

[52] Energy Information Administration, Natural Gas Prices. https://www.eia.gov/dnav/ng/hist/n3010us3a.htm (Accessed on April 22, 2016)

[53] Appliance recycling participants were excluded from the table because that program was discontinued in 2015.

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7 Special Studies

7.1 Declining Program Participation Rates

The 2012-2013 process evaluation report[54] noted that program participation rates, based on the number of rebated measures, have declined since 2010. The 2012-2013 process evaluation report also suggested that explanations for the decline in participation included a decrease in the list of rebated measures and a reduction in the incentive amounts that Avista offered in response to declining measurable gross savings or higher freeridership. To investigate this issue further, the evaluation team examined the list of rebated measures in both the nonresidential and residential 2010-2015 program databases to assess the potential impact that the reduction in the rebated measures list and the reduced incentive amounts had on participation. The evaluation team also examined whether a decrease in repeat participation may have partly contributed to the decline in participation. Finally, specifically for the residential sector, the evaluation team examined whether evidence exists that the availability of qualifying measures may have changed from 2010 to 2015, possibly contributing to the decline in participation.

7.1.1 Nonresidential Participation Trends

7.1.1.1 Discontinued Measures and Reduced Rebate Incentives

For the analysis of discontinued program measures and reduced incentives the evaluation team combined information from the 2010 to 2015 program databases. The combined 2010-2015 nonresidential program database contained 13,845 rebated measures. The evaluation team focused on analyzing the prescriptive and Energy Smart Grocer rebated measures only because these measures combined accounted for 91% of all the measures in the combined 2010-2015 database, respectively. The evaluation team excluded the Site Specific measures from this analysis because this program provides custom incentives based on measured energy savings, and so there is no standardized unit of analysis. The evaluation team excluded Oregon measures because this evaluation focuses on Idaho and Washington and excluded measures classified under "UCON MF" because of limited data.

[54] Cadmus (2014). *Avista 2012-2013 Process Evaluation Report.*

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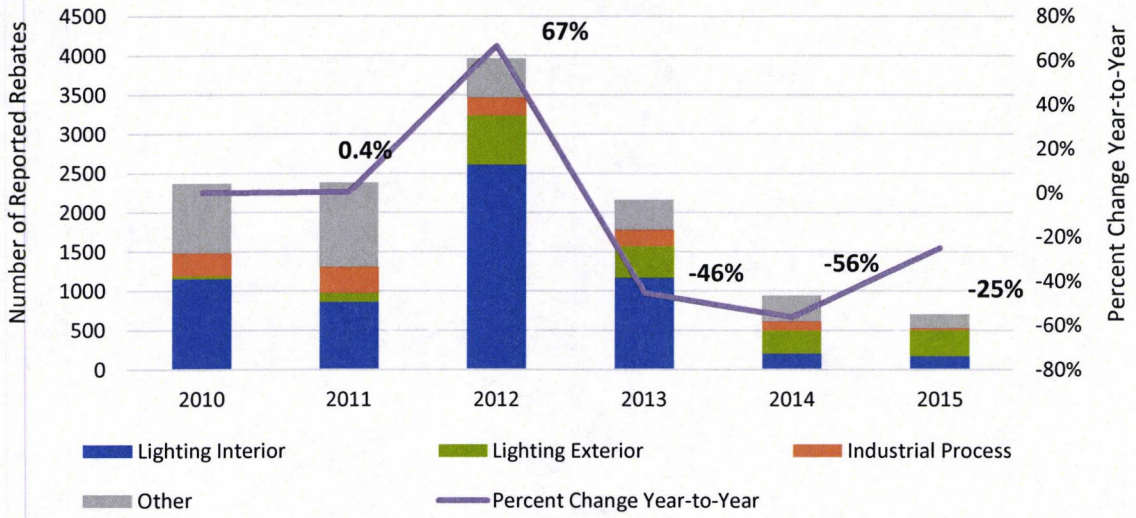
Also note that we combined prescriptive and Energy Smart Grocer rebated measures, when reporting findings.[55]

The overall number of rebates declined in 2013, 2014, and 2015. The rate of decline slowed down in 2015 (Figure 7-1). Lighting rebates, in particular, abruptly increased in 2012 and declined substantially in subsequent years. Industrial process rebates started to decline in 2012 and continued declining in subsequent years. These lighting and industrial process measures accounted for 73% of all the rebated measures examined in the 2010-2015 data.

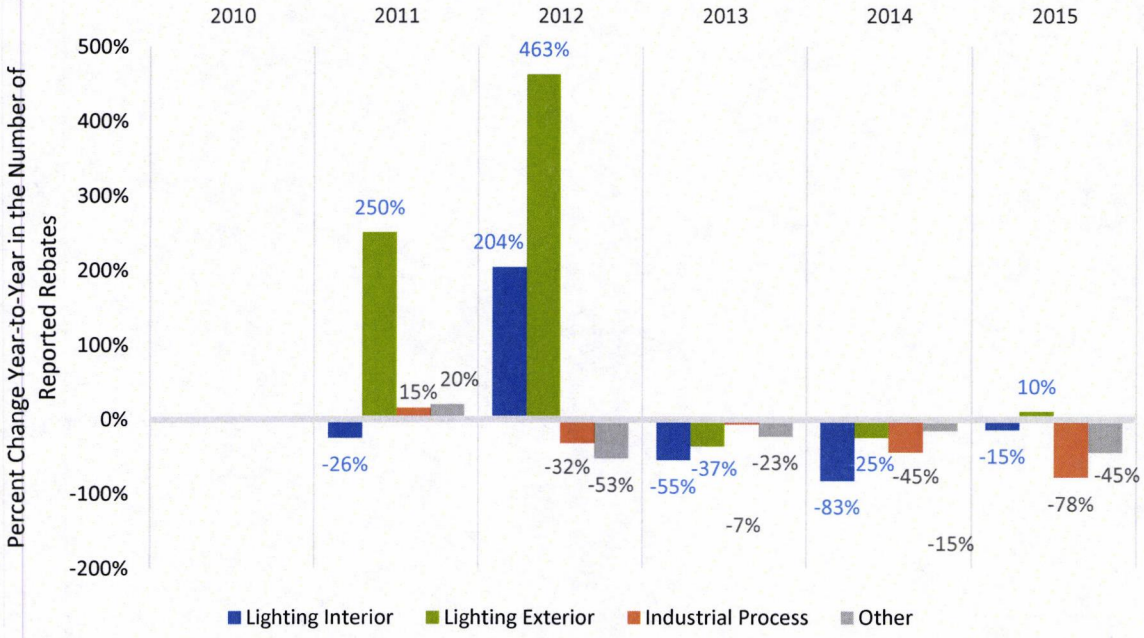
Figure 7-1: Reported Number of Nonresidential Rebates, 2010-2015 Nonresidential Program Data



The quantity of interior and exterior lighting rebates peaked in 2012 and declined by 55% and 37%, respectively, from 2012 to 2013 (Figure 7-2).

[55] The Energy Smart Grocer measures accounted for a small proportion of all the measures in the database – less than 15%. Additionally, the team struggled in separating Energy Smart Grocer measures from the same measures in the prescriptive program in the database.

Figure 7-2: Percent Change Year-to-Year by Measure Rebate Type, 2010-2015 Nonresidential Program Data*



* The percentage shown above or below each column represents the percentage change in rebates that year relative to the previous year.

The abrupt increase in lighting rebates in 2012 was most likely related to changes in linear fluorescent lamp standards. Effective July 14, 2012, all linear florescent lamps manufactured or imported for sale in the U.S. had to meet more stringent lighting standards as stipulated by the Energy Policy Act (EPACT) of 2005 and Independence and Security Act (EISA) of 2007. This resulted in the cessation of U.S. production and importation of T12 fluorescent lamps after July, 2012. Likely in response to this new standard, which effectively shifted the baseline for commercial lighting technologies, Avista changed the rebate amounts for lighting measures. Avista's average rebate amounts per BTU[56] saved decreased from 2012 to 2015 for lighting measures (Table 7-1; this data comes from the 2010-2015 program database). Nonresidential customers and contractors may have anticipated this reduction in rebate amounts by Avista after 2012, which could explain the abrupt increase in the quantity of the lighting upgrades through the Avista's programs in 2012.

[56] BTU= British Thermal Unit. Many records in the database included both electric (kWh) and gas (Therm) savings. To estimate total (electric+gas) savings, the evaluation team converted kWh and Therm savings for each record to BTUs, a traditional unit of energy.

Table 7-1: Lighting Rebate Amounts By Energy Savings By Measure Type, 2010-2015 Nonresidential Program Data

Measures	Average Rebate Amount Per 1000 BTUs Saved ($/1000 BTUs)					
	2010	2011	2012	2013	2014	2015
Lighting Interior	0.07	0.05	0.29	1.29	0.04	0.05
Lighting Exterior	0.03	0.04	0.25	0.08	0.11	0.06

To further assess changes in participation, the evaluation team examined the rebated measures in the 2010-2015 program data and DSM business plans to determine which nonresidential measures were discontinued since 2010. To quantify the effect of the discontinued measures on overall participation, the evaluation team looked at the difference between two quantities: 1) the quantity of measures that would have been incented in 2015 if the non-discontinued measures had the same participation as in 2013, when the lighting standards shifted (the "2015 theoretical" quantity); and 2) the quantity of measures that were actually incented in 2015 (the "2015 actual" quantity).

Table 7-2 shows each rebated measure, whether the measure was available ("Y") or not available ("N") each year from 2010 to 2015, the number of 2013 rebates for that measure, and the "2015 theoretical" and "2015 actual" quantities described above. Comparison of the 2015 theoretical and actual quantities shows that most of the overall decline in the number of rebates was not attributable to the discontinued measures. Discontinued measures accounted for a reduction of 27 measures, representing 2% of the total decline of 1,356 measures (Table 7-2).

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Table 7-2: Theoretical Versus Actual Participation, Accounting for Discontinued Measures, 2010-2015 Nonresidential Program Data

Measures[b]	Availability of Rebates[a]						Baseline: # of 2013 rebates	2015 theoretical quantity[c]	2015 actual quantity
	2010	2011	2012	2013	2014	2015			
Top 3 measures, accounting for 73% of all 2010-2015 rebates									
Lighting Interior	Y	Y	Y	Y	Y	Y	1,164	1,164	330
Lighting Exterior	Y	Y	Y	Y	Y	Y	398	398	169
Industrial Process	Y	Y	Y	Y	Y	Y	210	210	25
Other measures, accounting for 27% of all 2010-2015 rebates									
Case lighting	Y	Y	Y	Y	Y	Y	128	128	36
Food service equipment	Y	Y	Y	Y	Y	Y	83	83	72
Windows and insulation	N	N	Y	Y	Y	Y	73	73	21
HVAC	Y	Y	Y	Y	Y	Y	41	41	34
Green motors	Y	Y	Y	Y	Y	Y	15	15	5
Motor controls, HVAC	Y	Y	Y	Y	Y	Y	12	12	14
Appliances	Y	Y	Y	Y	Y	Y	11	11	0
Commercial water heater	Y	N	N	N	Y	Y	0	6[d]	1
Compressed air	Y	Y	N	Y	N	Y	1	1	0
PC network controls	Y	Y	Y	Y	Y	Y	0	0	0
Shell	Y	Y	Y	Y	Y	Y	0	0	0
Motors	Y	Y	Y	Y	N	N	0	0	0
Renewables	Y	Y	Y	Y	N	N	3	0	0
Generator block heater	N	Y	Y	Y	Y	N	24	0	0
TOTAL	-	-	-	-	-	-	**2,163**	**2,136**	**707**
Number of rebates decline from baseline								**27**	**1,356**

[a] Y means "yes, available that year" and N means "no, not available that year."
[b] Excludes steam trap replacement, vending machine, side-stream filtration, refrigerated warehousing, LED traffic signals, demand controlled ventilation, LEED certification, motor control (industrial), and multifamily measures, as those were not available any year from 2013 to 2015 and so, by definition, do not contribute to any of the counts.
[c] Assumes the non-discontinued measures would have had the same number of rebates as in 2013.
[d] Used 2014 rather than 2013 rebate number since this measure was not available in 2013.

Next, the evaluation team examined changes to the rebate amounts from 2013 to 2015 to assess whether reduced incentives may have affected participation. The average rebate amounts per BTU saved declined for each measure from 2013 to 2015, except for the HVAC measure (Table 7-3). As the rebate amounts declined so did the quantity of rebated measures (Table 7-3; Correlation=0.5), indicating that the reduced rebates could have affected participation rates.

Table 7-3: Percent Change in Rebate Amounts and Counts, 2010-2015 Nonresidential Program Data

Measures	Average Rebate Amount Per 1000 BTUs ($/1000 BTUs)						% change in avg. rebate, $ per 1000 BTUs	% change in rebate quantity
	2010	2011	2012	2013	2014	2015	2013-2015	2013-2015
Lighting Interior	0.07	0.05	0.29	1.29	0.04	0.05	-96%	-85%
Lighting Exterior	0.03	0.04	0.25	0.08	0.11	0.06	-25%	-17%
Industrial Process	0.04	0.04	0.04	0.04	0.04	0.03	-15%	-88%
Case lighting	0.06	0.05	0.06	0.06	0.05	0.04	-33%	-72%
Food service eq.	0.03	0.02	0.02	0.03	0.03	0.02	-31%	-13%
Windows and insulation	-	-	0.05	0.05	0.06	0.03	-43%	-71%
HVAC	0.04	0.03	0.02	0.02	0.02	0.02	30%	-17%
Green motors	0.03	0.03	0.03	0.04	0.02	0.02	-50%	-67%
Motor controls, HVAC	0.02	0.03	0.02	0.04	0.02	0.03	-32%	17%

Note: The evaluation team excluded discontinued measures from this analysis. The evaluation team also excluded compressed air, PC network controls, shell (not windows and insulation), appliances, and water heater measures from this analysis because no rebates were recorded in 2015 for these measures (even though 2015 DSM business plan notes rebates were offered) or rebates were offered recently (not much data to assess percent change).

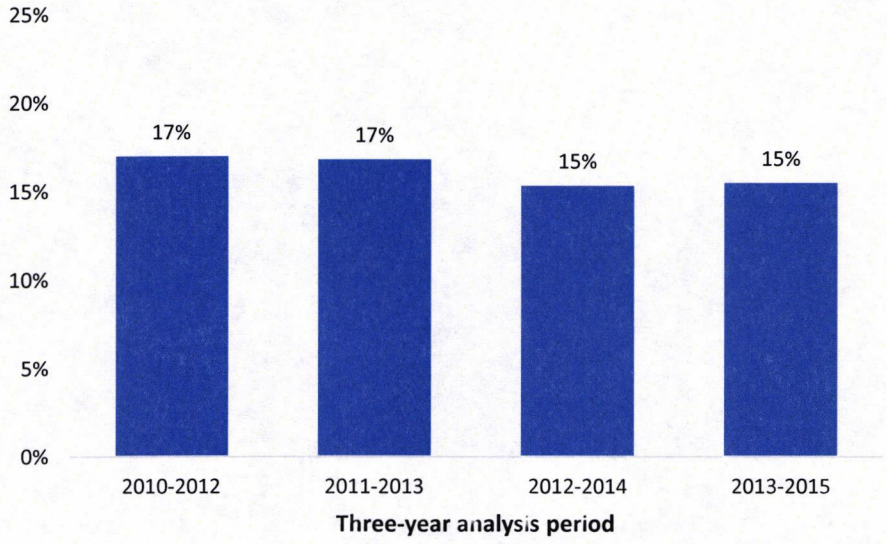
7.1.1.2 Analysis of Repeat Participation Among Customers

The evaluation team conducted another analysis to assess patterns of repeat participation among nonresidential customers over rolling three-year periods, using the combined 2010-2015 program database. For each three-year period (2010-2012, 2011-2013, 2012-2014, and 2013-2015), the evaluation team identified the number of unique customers that *either*: 1) participated in more than one program; or 2) participated in the same program more than one time within that three-year period. (The team refers to these customers as repeat participants). For each of those three-year periods, dividing the number of repeat participants by the total number of unique customers that participated in any program within that three-year period produced the repeat participation rate for that period. For example, the formula for calculating repeat participation within the period from 2010 to 2012 was:

$$\text{Repeat participation rate} = \frac{\text{The total number of unique customers that either participated in multiple programs within 2010-2012 or participated in the same program multiple times within 2010-2012}}{\text{The total number of unique customers that participated in any programs within 2010-2012}}$$

Repeat participation rates declined slightly from 2010 to 2015 (Figure 7-3). Repeat participation also appears to be an important driver of participation since more than one-tenth of nonresidential participants participated in multiple programs or multiple times since 2010.

Figure 7-3: Percent of Nonresidential Customers Participating in Multiple Programs or Same Program Multiple Times, 2010-2015 Nonresidential Program Data



7.1.2 Residential Participation Trends

7.1.2.1 Discontinued Measures and Reduced Rebate Incentives

For the analysis of discontinued residential program measures and reduced incentives, the evaluation team combined information from the 2010-2013 program database with program data from 2014 and 2015. The combined 2010-2015 residential program database contained 100,796 measures, of which the evaluation team analyzed 96,343 measures (or 96% of all the measures in the database).[57] The evaluation team binned these measures into six categories: 1) ENERGY STAR appliances, 2) shell, 3) HVAC, 4) fuel conversions (or Fuel Efficiency program), 5) water heater, and 6) ENERGY STAR Homes measures. The 2010-2013 program database lacked the information necessary to identify low-income program participants, who also couldn't be uniquely identified based on the measure. Thus, the subsequent analyses and findings document overall participation trends because the evaluation team was not able to separate low-income program participants from other rebate program participants.[58]

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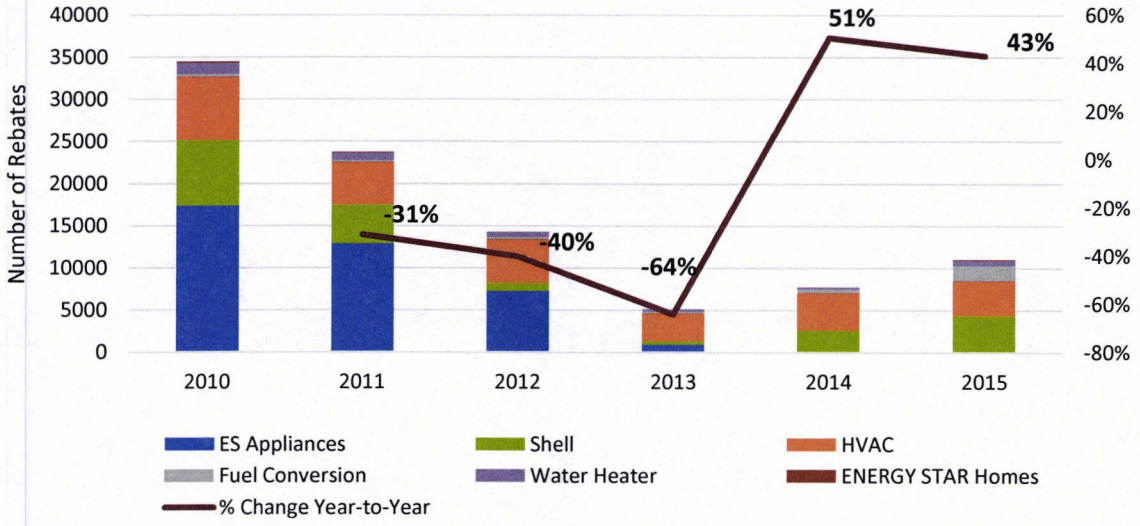
[57] The evaluation team did not have a complete set of data for all the measures. For example, the program data extracts contained no information on 2010-2013 Appliance Recycling and UCON duct sealing measures.

[58] 2014 and 2015 program data included the information on low-income participants. About 10% of all 2014 and 2015 measures were installed in low-income residences.

The overall number of rebated measures declined from 2010 to 2013 (Figure 7-4). In 2014 and 2015, the number of rebates increased but were well below the levels reported in 2010.

Figure 7-4: Reported Number of Residential Rebates, 2010-2015 Program Data



According to the prior evaluation, Avista staff believed that the decline in the number of rebates was due to the expiration of tax credits for energy efficient upgrades and high-efficiency home appliances offered under the American Recovery and Reinvestment Act (ARRA) of 2009.[59] Staff reported that these tax credits likely prompted an increase in rebate program participation in 2009 and 2010, followed by a decrease in participation by 2011 when ARRA incentives started to wane.

Further analysis revealed that ENERGY STAR appliances, in particular, accounted for 40% of all the rebated measures examined in the 2010-2015 data. Avista ceased offering rebates for ENERGY STAR appliances in 2013, except to low-income customers.[60] This likely explains the abrupt drop in appliance measures in 2013 and thereafter, as rebates were not discontinued for any other measures.[61]

To quantify the effect of the discontinued appliance measures on overall participation, the evaluation team looked at the difference between two quantities: 1) the quantity of measures

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[59] Cadmus (2014). *Avista 2012-2013 Process Evaluation Report.*

[60] There is no incentive budget in 2013-2015 Avista's DSM plans for appliance measures.

[61] The one exception is that the Avista 2013 DSM plan did not include water heater rebates in 2013, but did include them in all other years of this analysis.

that would have been incented in 2015 if the non-discontinued measures had the same participation as in 2010,[62] when the decline in rebate quantity began (the "2015 theoretical" quantity); and 2) the quantity of measures that were actually incented in 2015 (the "2015 actual" quantity). Note that the appliance measure was not discontinued for low-income customers and there were 26 low-income appliance rebates in 2015. Therefore, the first of the above quantities also assumes there would have been 26 low-income appliance rebates in 2015.

Table 7-2 shows each rebated measure, whether the measure was available ("Y") or not available ("N") each year from 2010 to 2015, the number of 2010 rebates for that measure, and the "2015 theoretical" and "2015 actual" quantities described above. Comparison of the 2015 theoretical and actual quantities shows that most of the overall decline in the number of rebates was attributed to the discontinued appliance measures, which accounted for 17,332 of the total decline of 23,453 measures, or 74% of the total (Table 7-2).

Table 7-4: Theoretical Versus Actual Participation, Accounting for Discontinued Measures, 2010-2015 Residential Program Data

b	Availability of Rebates						Baseline	2015	2015
Measures	2010	2011	2012	2013	2014	2015	2010, # of rebates	Projected # of rebates**	Actual # of rebates
Appliances	Y	Y	Y	N*	N*	N*	17358	26	26
Shell	Y	Y	Y	Y	Y	Y	7728	7728	4295
HVAC	Y	Y	Y	Y	Y	Y	7562	7562	4181
Fuel Conversion	Y	Y	Y	Y	Y	Y	256	256	1742
Water Heater	Y	Y	Y	N*	Y	Y	1345	1345	688
ENERGY STAR Homes	Y	Y	Y	Y	Y	Y	220	220	84
TOTAL	-	-	-	-	-	-	**34,469**	**17,137**	**11,011**
Number of rebates decline from baseline	-	-	-	-	-	-		**17,332**	**23,458**

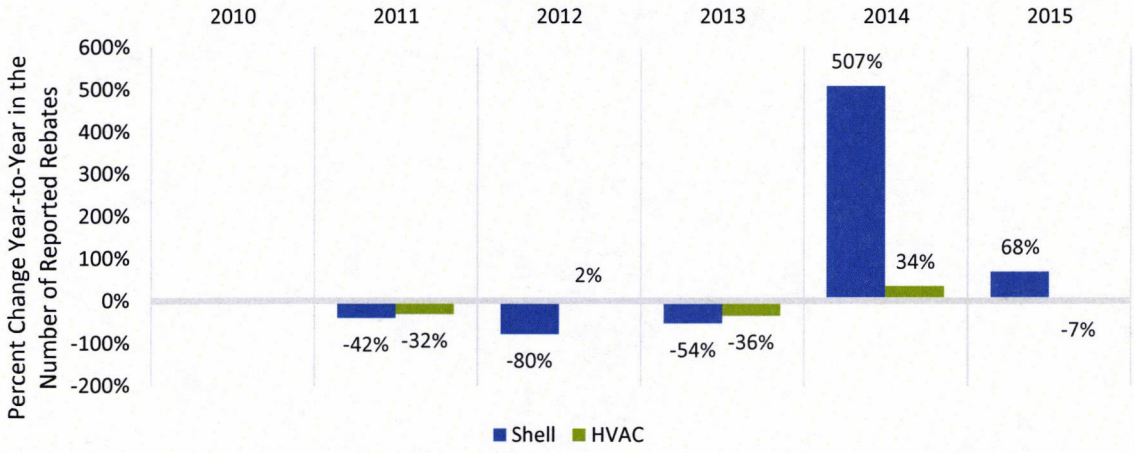
* Low-income customers still received Avista's rebates for appliance or water heaters.

** The number of rebates is the same as in 2010, except for discontinued measures.

Appliances were the most common measures in the 2010-2015 program data, followed by shell, and HVAC measures. With regard to shell and HVAC measures, these measures declined from 2010-2013, but not in 2014 and 2015. As shown in Figure 7-5, shell rebates increased by 507% and 68% from 2013 to 2014 and 2014 to 2015, respectively. HVAC rebates increased by 34% from 2013 to 2014 and decreased by 7% from 2014 to 2015.

[62] In contrast with the nonresidential analysis, which used 2013 as the baseline, the evaluation team selected 2010 as the baseline because the team wanted to include the period when ARRA funding was available for residential energy efficiency upgrades, which the previous evaluation identified as one reason for increased participation in Avista's rebate programs.

Figure 7-5: Percent Change Year-to-Year by Measure Rebate Type, 2010-2015 Residential Program Data



Because the shell and HVAC measures accounted for 52% of all the measures in the 2010-2015 program data, the evaluation team examined rebate amounts associated with these measures to assess whether changes in incentive amounts affected shell and HVAC program participation. To compare changes to the rebate amounts across the various shell and HVAC measures, the evaluation team divided rebate amounts with estimated energy savings for each record in the database. Many records in the database included both electric (kWh) and gas (therm) savings. To estimate total (electric+gas) savings, the evaluation team converted kWh and Therm savings for each record to British Thermal Units or BTUs.

Among the four shell measures examined and listed in Table 7-3, one measure in particular, windows, accounted for nearly two-thirds of the total number of shell measures contained in the 2010-2015 program database. The average rebate amount per BTU saved for windows declined from 2010 to 2013 and then increased from 2013 to 2015 (Table 7-3). This change could explain why participation in the shell program declined from 2010 to 2013 and then increased in 2014 and 2015.

Among the five HVAC measures listed in Table 7-3, three accounted for nearly all the HVAC measures in the 2010-2015 program data: high efficiency furnace or boiler, high efficiency air-source heat pump, and variable speed motor. The average rebate amount per BTU saved for air source heat pumps and variable speed motors increased from 2010 to 2015, while the quantity of rebated measures for air source heat pumps and variable speed motors decreased (Table 7-5). This indicates that the higher incentives per BTU saved in 2015 compared to 2010 did not halt the decline in incented air source heat pump and variable speed motor installations. The average rebate amount per BTU saved for the natural gas furnace or boiler measure decreased from 2010 to 2015. This decrease in rebate amount may be associated with the decrease in the quantity of natural gas furnace or boiler measures from 2010 to 2015 (Table 7-5).

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Table 7-5: Percent Change in Rebate Amounts and Counts, 2010-2015 Residential Program Data

Measures	Average Rebate Amount Per 1000 BTUs ($/1000 BTUs)						% change in avg. rebate $ per 1000 BTUs	% change in rebate quantity
	2010	2011	2012	2013	2014	2015	2010-2015	2010-2015
Shell								
Windows*	0.036	0.034	0.031	0.000	0.047	0.054	48%	-44%
Attic Insulation	0.035	0.031	0.044	0.060	0.035	0.030	-14%	-64%
Floor Insulation	0.014	0.015	0.017	0.023	0.036	0.027	90%	-33%
Wall Insulation	0.013	0.016	0.016	0.025	0.046	0.034	161%	-65%
HVAC								
Nat. Gas Boiler/Furnace*	0.033	0.033	0.038	0.038	0.028	0.024	-26%	-52%
Air Source Heat Pump*	0.038	0.037	0.140	0.097	0.056	0.054	43%	-80%
Variable Speed Motor*	0.052	0.052	0.065	0.067	0.067	0.067	28%	-24%
Ductless Heat Pump	0.071	0.073	0.073	0.073	0.000	0.000	-100%	-100%
A/C Replacement	0.054	0.000	0.000	0.000	0.000	0.000	-100%	-100%

Note: Program data included a few additional shell and HVAC measures in 2014 and 2015. Because these measures were not listed in 2010-2013 data extract, the evaluation team excluded these measures from this analysis.

* These are the most frequent measures and they constitute the majority of the measures in the shell or HVAC programs.

7.1.2.2 Analysis of Repeat Participation Among Customers

The evaluation team conducted another analysis to assess patterns of repeat participation among residential customers over rolling three-year periods, using data from the program databases from 2010 through 2014.[63] For each three-year period (2010-2012, 2011-2013, and 2012-2014), the evaluation team identified the number of unique customers that *either*: 1) participated in more than one program; or 2) participated in the same program more than one time within that three-year period. Then, for each of those three-year periods, the above quantity was divided by the total number of unique customers that participated in any program within that three-year period. For example, the formula for calculating repeat participation within the period from 2010 to 2012 was:

[63] The evaluation team had difficulty in matching participant ID variable with records in 2015 data.

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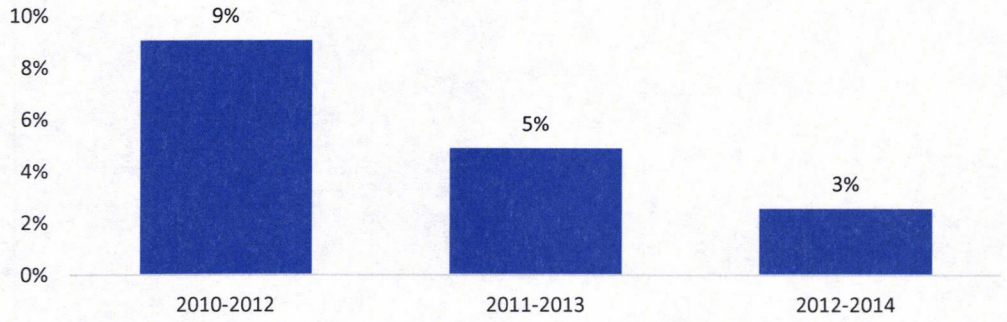
$$\text{Repeat participation rate} = \frac{\text{The total number of unique customers that either participated in multiple programs within 2010-2012 or participated in the same program multiple times within 2010-2012}}{\text{The total number of unique customers that participated in any programs within 2010-2012}}$$

Repeat participation rates declined threefold from 2010 to 2015, but this decline had little effect on overall participation rates since less than one-tenth of residential participants participated in multiple programs or multiple times since 2010 (Figure 7-6).

Figure 7-6: Percent of Residential Customers Participating in Multiple Programs or Same Program Multiple Times, 2010-2014 Residential Program Data



7.1.2.3 Analysis of Availability of Qualifying Measures at Lower Price Points

The evaluation team conducted a third analysis using available 2010-2015 program data to determine whether limited product availability may have affected program participation. Previous research conducted by the evaluation team for the Energy Trust of Oregon revealed that the proportion of rebated refrigerators at lower price points declined sharply over several years in the Pacific Northwest. A single brand dominated the lower-priced refrigerator models that qualified for rebates, suggesting that consumers had relatively few models to choose from at the lower end of the market. The evaluation team did not have actual market data on model availability, as it did for the Energy Trust analysis, but the evaluation team examined unit cost of the rebated measure to determine whether evidence exists of a change in model availability. Data on price paid were examined for these two measures: natural gas furnace/boiler and water heater.

Customers participating in Avista's HVAC program are buying furnaces or boilers at lower cost, on average, in 2015 than in the prior years. The average price of incented furnaces or boilers peaked in 2012 and then declined in subsequent years (this trend was significant; ANOVA at $p<0.05$). The average price in 2012 ($4,084), in particular, was significantly lower than the average price in 2015 ($3,756) (Tukey post-hoc test at $p<0.05$), indicating that in recent years participating customers have bought more incented units at lower price points. On the other

hand, customers participating in Avista's Water Heater program are buying water heaters at higher cost, on average, in 2014 and 2015 than in the prior years. The average price of incented water heater units increased since 2010. The lack of a consistent relationship between average price paid and participation rate does not support the hypothesis that the decline in participation resulted from a change in model availability at different price points.

7.2 Participation Rates Among Opower Behavioral Program Participants and Nonparticipants

The evaluation team analyzed participation data from Avista's residential Behavioral Program, which is administered by Opower (Opower program), to gather insight into the effectiveness of Opower's home energy reports at encouraging customers to do more energy savings activities and/or participate in Avista's rebate programs. This analysis specifically investigates the effectiveness of one particular combination: Opower plus Avista rebates.

The evaluation team used randomized-control trial participation data from Opower combined with Avista rebate participation data to analyze differences in energy savings across four groups of customers in a quasi-experimental study. The team performed this analysis to determine whether participation in both the Opower program and one or more Avista rebate programs resulted in more electricity savings than the combined savings associated with programs individually. That is, the evaluation team wanted to determine whether there was a "multiplier effect" associated with customer participation in both the Opower program and the rebate programs.

The four customer groups the team analyzed were:

- *Opower+Rebate participants,* who participated in both the Opower program and one or more Avista rebate programs
- *Opower-only participants,* who participated in only the Opower program but not in an Avista rebate program
- *Rebate-only participants* who participated only in one or more Avista rebate programs but not in the Opower program
- *Nonparticipants* who did not participate in either the Opower program or in one of the Avista rebate programs

7.2.1 Data and Methods

7.2.1.1 Data Preparation

A sample of over 86,000 Avista customers in Washington and Idaho were randomly assigned by Opower to two groups: a treatment group that received home energy reports from Opower (Opower participants) and a control group that did not receive the reports (Opower nonparticipants) (Table 7-6). The evaluation team prepared the participation data for

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Washington and Idaho customers (see impact evaluation reports for more details on data preparation) as follows:

- Calendarized customer monthly billing data into calendar months, and
- Removed customers with duplicate billing data, customers with no billing data after the month when the Opower reports began, and customers with no billing data for at least 12 months before the Opower reports began.

The evaluation team combined data from the two states into a single dataset for this analysis (Table 7-6). For this analysis, the evaluation team also required a data set in which the proportions of participants and nonparticipants in Idaho matched the proportions of participants and nonparticipants in Washington. In the original data, the percentage of Opower participants and nonparticipants in Idaho was 66% and 34% respectively, and the proportions for Washington customers was 79% and 21%, respectively. To achieve proportionality between the states, the team excluded a random sample of 5,380 Opower nonparticipant customers in Idaho (Table 7-6).

Table 7-6: Number of Opower Participants and Nonparticipants Before and After Removing Random Sample from Idaho Control Group

	Total		Washington		Idaho	
	N	%	N	%	N	%
Original Sample Sizes						
Opower nonparticipants	22,579	26.2%	11,292	21.3%	11,287	34.1%
Opower participants	63,502	73.8%	41,695	78.7%	21,807	65.9%
TOTAL	**86,081**	**100%**	**52,987**	**100%**	**33,094**	**100%**
Sample sizes after removing random sample of Idaho nonparticipant customers						
Opower nonparticipants	17,199	21.3%	11,292	21.3%	5,907	21.3%
Opower participants	63,502	78.7%	41,695	78.7%	21,807	78.7%
TOTAL	**80,701**	**100%**	**52,987**	**100%**	**33,094**	**100%**

In accordance with the program, Opower participants began receiving the home energy reports in June and July of 2013, and continued receiving reports through December 2015 (treatment period).[64] However, due to a change to Avista's customer billing system during the first half of 2015, none of the Opower participants received Opower reports between February and July of

[64] Opower participants received eight home energy reports in a year, or two per quarter of a year.

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2015 (pause period). Opower participants began receiving reports again from August 2015 through December 2015, the end of the evaluation period.[65]

During the treatment period between July 2013 and December 2015, about four percent of the Opower participants and nonparticipants participated in one or more Avista rebate programs (Table 7-7).[66] The evaluation team merged the rebate program participation data with the Opower program participation data.

Table 7-7: Number of Opower and Avista Rebate Participants and Nonparticipants

	Opower Participant		Opower Nonparticipant		Total	
	N	%	N	%	N	%
Avista Rebate Participant	2,531	4.0%	656	3.8%	3,187	3.9%
Avista Rebate Nonparticipant	60,971	96.0%	16,543	96.2%	77,514	96.1%
TOTAL	**63,502**	**100%**	**17,199**	**100%**	**80,701**	**100%**

Calendarized monthly electricity usage data from billing records, including total monthly kWhs and average daily kWhs, were available for all customers in the dataset for 16 months preceding July 2013 (the pre-treatment period, March 2012 to June 2013). These data were also available for up to 30 months during the treatment period (July 2013 to December 2015). The data were structured such that each row represented a calendar month of customer billing data, in which each unique customer could have up to 46 rows, or months, of billing data.

About 22% of customers opted-out of the Opower program or moved residences at some point during the treatment period such that 63,283 customers remained in the dataset through the entire treatment period. The evaluation team included the customers that opted out or moved residences in its analyses to maintain the quasi-experimental design of the study and to avoid reducing the relatively small number of Avista rebate participants in the dataset.[67]

For the analysis, the team used the following variables:

- Opower_ID: unique identifier for each customer.

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[65] Opower participants continued to receive Opower reports after December 2015 but all subsequent months fall outside the current evaluation period and are not included in analyses.

[66] Avista's "rebate" programs include rebates for high efficiency heating, ventilation, and air conditioning equipment upgrades, high efficiency water heating equipment upgrades, conversions from electric to natural gas space and water heating equipment, insulation and windows, and high efficiency equipment for ENERGY STAR® homes; the team also included UCONS direct install duct sealing and incentives for appliance recycling.

[67] Nonparticipants could not "opt out" since they were not receiving Opower reports, and the team had no way to identify which nonparticipants would have opted out if they had been receiving the Opower reports.

- Daily_Average_kWh: measure of average daily kWh usage for each customer and month.
- Daily_Average_kWh_Logged: logarithmic measure of average daily kWh usage for each customer and month.
- Daily_Average_kWh_Preusage: measure of average daily kWh usage for each customer and month in the pre-treatment period, coded to respective months in the treatment period (e.g. daily average kWh usage for each customer in May 2013 is coded for the customer in May 2014 and in May 2015).
- Year_Month: measure of time specifying the year and month of each electric bill.
- Pre_Post: indicator of the pre-treatment period (coded '0' for each month, March 2012 to June 2013) and treatment period (coded '1' for each month, July 2013 to December 2015).
- Opower_Participant: indicator of whether the customer is an Opower participant (coded '1' for all months) or Opower nonparticipant (coded '0' for all months).
- Avista_Rebate_Participant: indicator of whether the customer is an Avista rebate participant (coded '1' for the month in which they participated and all subsequent months and coded '0' for all months prior to participation) or nonparticipant (coded '0' for all months).

7.2.1.2 Analysis Methods

The evaluation team analyzed the prepared data set to determine whether participation in one or more Avista rebate programs and the Opower program results in more electricity savings than the sum of the electricity savings attributed to participation in each program separately. That is, the evaluation team wanted to determine whether there was a "multiplier effect" associated with customer participation in both the Opower program and the rebate programs. To do this, the evaluation team constructed cumulative and monthly lagged dependent variable (LDV) regression models that estimate electricity savings of Opower-only, Avista Rebate-only, and Opower+Avista Rebate program participation, compared to nonparticipants, using daily average kWh usage as the dependent variable.

The team used two different statistical regression methods to estimate the differences in electricity savings among the different customer groups. With the first method, the evaluation team included binary (yes/no) indicator variables to denote participation in the Opower and Avista rebate programs along with another indicator variable (an interaction term) that indicated whether the customer was a participant in both programs.[68] In the second method, the team

68 LDV Cumulative interaction model: Daily_average_kWh_usage = Opower_participant(β) + Avista_Rebate_participant (β) + Opower_participant (β)*Avista_Rebate_participant (β) + year_month+ daily_average_kWh_preusage + ε

LDV Monthly interaction model: Daily_average_kWh_usage = ([HER_participant_group(β) + Rebate_participant_group(β) + HER_participant_group(β)*Rebate_participant_group(β)] by year_month) + year_month + daily_average_kWh_preusage + ε

conducted separate regression models for each of the following six group comparisons.[69] The group comparison models do not control for the excluded groups like the interaction models do but the team performed these group comparison models as verification that results from the interaction models are robust.

- Nonparticipants (0) vs. Opower-only participants (1)
- Nonparticipants (0) vs. Avista Rebate-only participants (1)
- Nonparticipants (0) vs. Opower+Avista rebate participants (1)
- Opower-only (0) vs. Avista Rebate-only participants (1)
- Opower-only (0) vs. Opower+Avista Rebate participants (1)
- Avista Rebate-only (0) vs. Opower+Avista Rebate participants (1)

Electricity savings were measured in these models by comparing the actual daily average kWh usage (from monthly billing data) in the treatment period across the four groups, controlling for average daily kWh usage during the months in the pre-treatment period. The percent electricity savings were measured by replacing actual daily average kWh usage with the logarithmic measure of daily average kWh usage.

Due to the quasi-experimental design of the study, in which customers participated in Avista rebate programs in different months of the treatment period, there were too few Avista Rebate-only participants in the first three months of the treatment period ($n < 45$) to have the statistical power needed to include these data in the analyses. In addition, the team excluded from analyses data from customers using 500 daily kWhs or more in a month (n=48).

7.2.2 Findings

The evaluation team estimated the average daily electricity usage differences and percent electricity savings across the four customer groups: nonparticipants, Opower-only participants, Avista Rebate-only participants, and Opower+Avista Rebate participants. This section first describes differences between these groups and then answers the question about whether the combined Opower+Avista Rebate results in more electricity savings than the sum of the savings attributed to each program separately.

During the pre-treatment period, nonparticipants and Opower-only participants had the lowest average daily kWh usage, followed by the Opower+Avista Rebate participants and Avista

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69 LDV Cumulative comparison models: Daily_average_kWh_usage = group1vsgroup2(β) + year_month + daily_average_kWh_preusage + ε

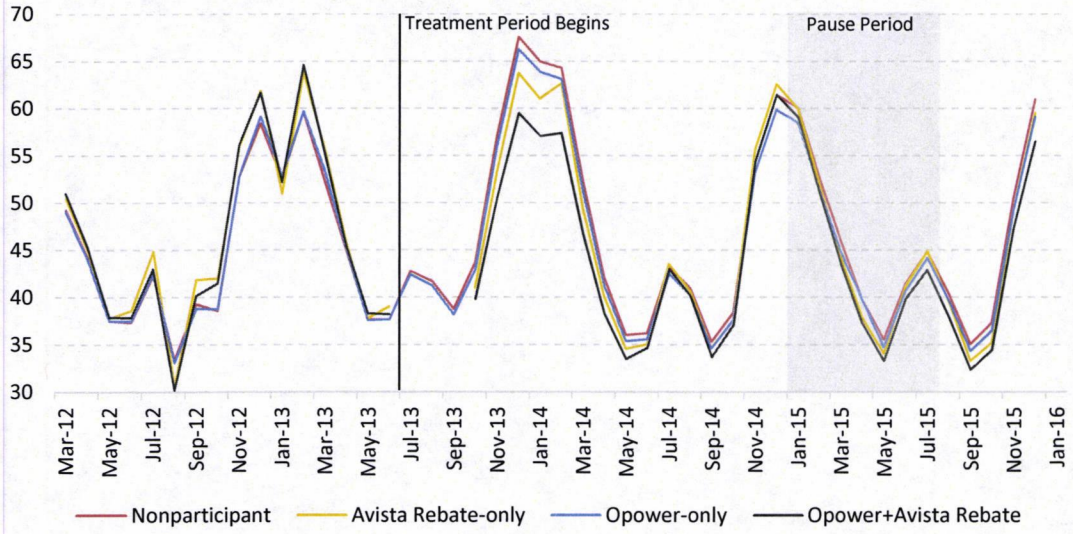
LDV Cumulative comparison models: Daily_average_kWh_usage = group1vsgroup2(β) by year_month + year_month + daily_average_kWh_preusage + ε

Rebate-only participants. However, during the treatment period, these trends changed such that Opower+Avista Rebate participants had the lowest average daily kWh usage, followed by Avista Rebate-only participants, Opower-only participants, and, lastly, nonparticipants (Table 7-8). These trends are illustrated across each month of the pre-treatment and treatment periods in Figure 7-7.

Table 7-8: Average Daily kWh Usage Before and During the Treatment Period by Group

	Nonparticipant	Opower-only	Avista Rebate-only	Opower+Avista Rebate
Pre-treatment period	44.8	44.9	46.4	46.2
Treatment period	46.9	46.0	44.9	43.6

Figure 7-7: Monthly Average Daily Energy Usage by Group



7.2.2.1 Cumulative LDV Model Results

The combination of the Opower home energy reports and Avista rebates appears to amplify electricity savings. Opower+Avista Rebate participants used significantly less electricity during the entire treatment period, on average, than the other groups (Figure 7-8; Table 1 in Appendix A). Opower+Avista Rebate participants, compared with nonparticipants (or the baseline), used 5.7% less electricity (or 2.82 kWh/day less).

These savings in electricity usage were significantly greater than the sum of the average savings attributed to the rebate programs alone (1.7%, or 1.35 kWh/day; Avista Rebate-only group versus baseline) plus the Opower program alone (1.7%, or 0.90 kWh/day; Opower-only group versus baseline). The sum of the savings from the two groups of customers individually resulted in 3.4% savings, or 2.25 kWh/day.

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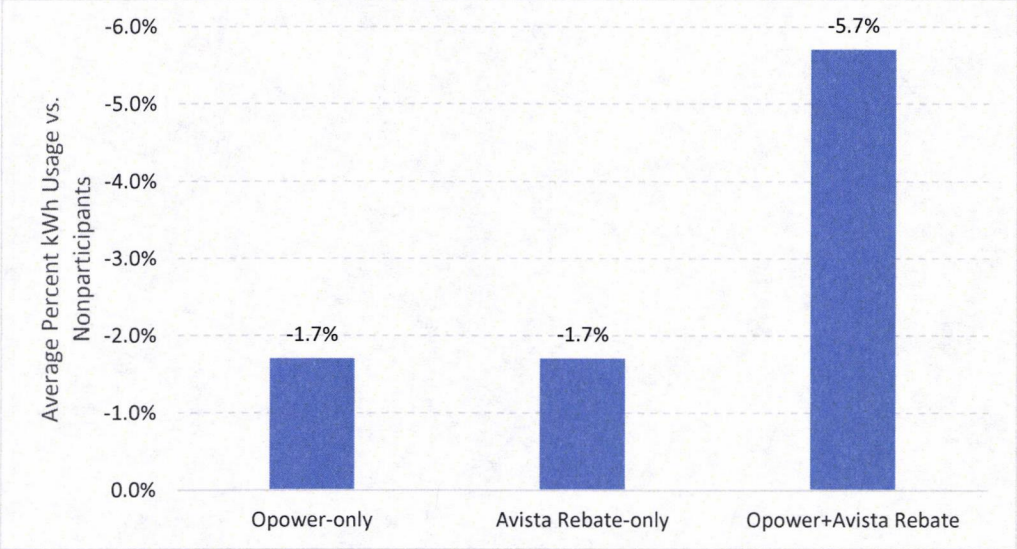
These results were determined using the LDV cumulative regression model with the interaction term (see equation in footnote 3 and full results in Table 1 in Appendix A). The model results are similar to but more conservative than the results from using the group comparison LDV cumulative regression models; these more conservative results were expected since the group comparison models do not include all customer groups in the same model (see Table 2 in Appendix A).

Figure 7-8: Average Cumulative Percent Electricity Usage Compared to Nonparticipants



* statistically significant at p≤.05

Note: These findings only take into account electric (kWh) savings. About 14% of Avista's rebate participants in the Opower dataset participated in Avista's Fuel Efficiency program, which means they converted from electric to natural gas space and/or water heating. These customers had an increase in natural gas consumption (therms) that is not accounted for in this and subsequent analyses.

7.2.2.2 Monthly LDV Model Results

Although the energy usage difference between the Opower plus Avista rebate group and the other customer groups is significant, further analyses revealed that Opower plus Avista rebate participation significantly affected electricity usage only during the early months of the treatment period. Figure 7-8 shows the average daily percent electricity usage for each group compared with nonparticipants and for each month in the treatment period from October 2013 to December 2015.[70] The Opower+Avista Rebate participants, compared with Nonparticipants, saved significantly more electricity per day, on average, during three months of the heating

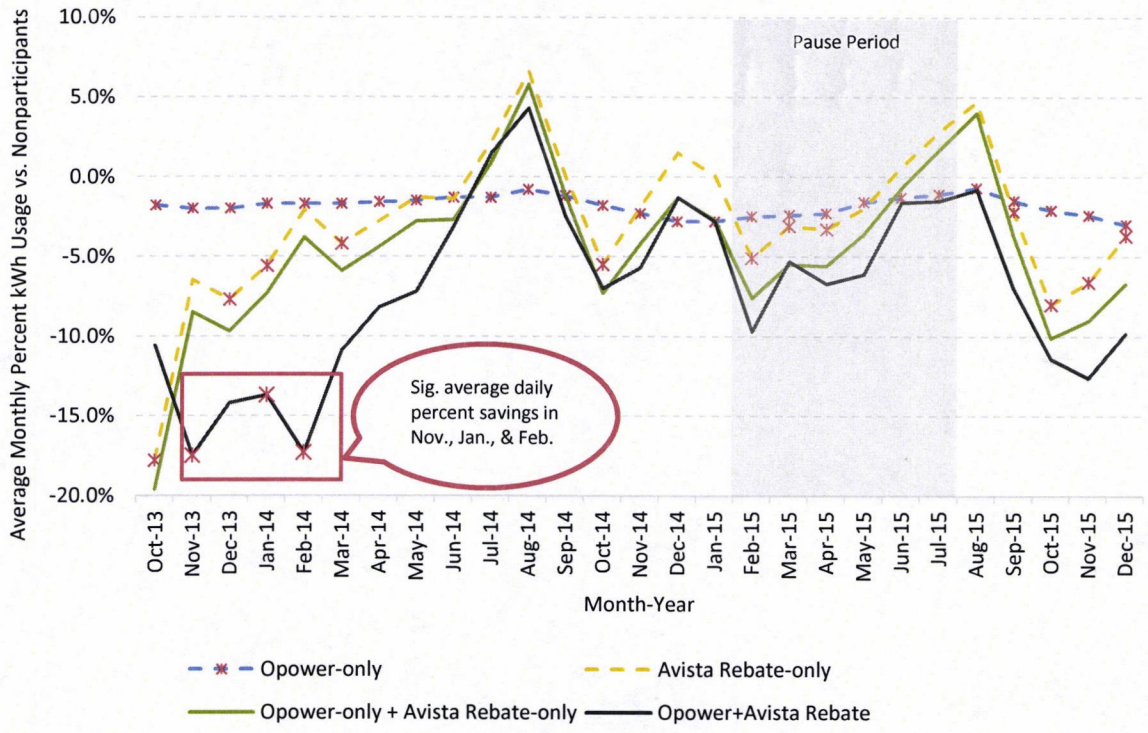
[70] The team excluded the months of July 2013 to September 2013 due to the small number of Avista rebate participants in the dataset for these months; the number of rebate participants is too small (n<45) to have the statistical power to perform the analysis.

season early in the treatment period of the Opower program: November 2013, January 2014, and February 2014.

As shown in Figure 7-8 although the average daily electricity usage was not significantly different during the following 2014-2015 heating season, these months coincide with the pause period for distributing the home energy reports to participating customers. The evaluation team lacked the data to extend its analysis through the 2015-2016 heating season; Figure 7-8 however, does show some evidence that Opower+Avista Rebate participants may have been saving more energy during these months.

The results from the LDV monthly regression model with the interaction term are similar to but more conservative than the results from the group comparison LDV monthly regression models (see equation in footnote 3 and full results in Table 1 in Appendix A); the more conservative results were expected since the group comparison models do not include all groups in the same model (see Table 2 in Appendix A).

Figure 7-8: Average Daily Percent Electricity Usage for Each Month Compared to Nonparticipants*



* Red asterisks (✳) indicate statistically significant average daily percent savings at p≤.10

7.2.3 Discussion

It appears that there is a multiplier effect when rebate participants receive home energy reports. The amplified Opower+Avista Rebate savings could be the result of additional electricity saving

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actions these customers undertook in their homes. Furthermore, the Opower home energy reports could be influencing the type and number of rebate programs in which these customers are participating. For example, a significantly higher percentage of Opower+Avista Rebate participants participated in the Fuel Efficiency rebate program to convert from electric to natural gas space and/or water heating compared with Avista Rebate-only participants (14% vs. 12%, respectively; p≤.10). In addition, Opower+Avista Rebate participants participated in significantly more rebate programs, on average, compared with Avista Rebate-only participants (1.55 vs. 1.46 rebate programs, respectively; p≤.05). However, Opower+Avista Rebate participants did not participate in Avista rebate programs at a higher rate compared with Avista Rebate-only participants (4% vs. 3.8%, respectively; not significantly different).

Collectively, these findings suggest that home energy reports can be effective at engaging customers and motivating them to take actions such as participating in Avista's rebate programs, such as the Fuel Efficiency program. These findings validate Avista's strategy to promote the rebate programs via the home energy reports.

These findings also suggest that customers who receive both home energy reports and rebates are saving even more energy than would be expected based on the average per-customer savings associated with each program. However, based on the current analysis, it is unclear whether the additional savings are only realized seasonally, or if the additional savings are a temporary phenomenon and lack persistence. Nevertheless, the possibility of a multiplier effect could have important implications for future program planning.

Future research should continue exploring the question of whether a combination of the home energy reports and rebate program participation results in more electric savings compared with participation in each program alone. For example, it is important to try and replicate these findings to ensure they are not an isolated outcome. It is also important to further analyze the savings to determine whether the savings are persistent and/or whether they are only realized during certain portions of the year (e.g., the heating season). Future research also should investigate further the type and number of rebate programs in which customers are participating and explore whether other program combinations could also amplify savings. Lastly, future research should further examine attribution of electricity savings from the combination of Opower participation and utility program participation to determine to what extent the Opower reports are influencing customers to participate in other programs.

7.3 Commercial Uptake of Simple Steps Lighting

The Simple Steps, Smart Savings program promotes the sales of CFL and LEDs to residential customers. Avista currently only reports savings for this offering through their residential lighting program. However, due to the delivery mechanism of the program (in-store buy down promotions), the evaluation team sought to understand if nonresidential customers were purchasing bulbs discounted through the program and if so, what percent of Simple Steps bulbs are 'leaking' into the nonresidential sector. The evaluation team estimated this "leakage" into the commercial sector using the responses of customers (participants and nonparticipants), as well

as by conducting a survey of large retailers that sell Simple Steps items. The following section describes this special study's objective, and results.

7.3.1 Objective

The objective of this study aimed to determine the distribution of Simple Steps, Smart Savings CFL and LED items across the residential and commercial sectors. A second purpose was to determine when retailers joined the Simple Steps program and identify future opportunities for savings and participation in the Simple Steps program.

7.3.2 Results

The evaluation team describes the results of each method below, beginning with the customer results.

7.3.2.1 Customer Results (Participant and Nonparticipant Surveys)

Of 375 surveyed nonresidential customers (participants and nonparticipants), 25 reported purchasing 2,685 Simple Steps items for their businesses. About half of the items were CFLs and half were LED items (Table 7-9).

Table 7-9: Summary Items in the Commercial Sector Attributable to Simple Steps

	Participants (*n*=305)		Nonparticipants (*n*=70)		Total (*n*=375)	
	Respondents	Items	Respondents	Items	Respondents	Items
Standard CFLs	11	1,030	3	60	14	1,090
Specialty CFLs	8	274	1	12	9	286
LEDs*	11	736	0	0	11	736
LED Fixtures	4	517	2	56	6	573
TOTAL	**21**	**2,557**	**4**	**128**	**25**	**2,685**

* Incented in 2014 and second half of 2015

Multiplying each sample total by the inverse of the respective sampling ratio produced estimates of 47,452 CFLs and 37,338 LEDs sold to nonresidential customers.[71] Those estimates represent 5.3% of the 896,485 of Simple Steps CFL items and 12.6% of the 295,870 of Simple Steps LED items sold in Avista territory that were sold to nonresidential customers, thus equating to the leakage percent of the program into this sector. The sample size of 375 provided 5% precision at 95% confidence.

[71] The "sampling ratio," also known as the "sampling fragment," is the ratio of the sample size to the population size (https://en.wikipedia.org/wiki/Sampling_fraction). Thus, the total numbers of Simple Steps CFLs and of LEDs reported by participants were multiplied by the inverse of the participant survey sampling ratio and the total numbers of Simple Steps CFLs and of LEDs reported by nonparticipants were multiplied by the inverse of the nonparticipant survey sampling ratio.

7.3.2.2 Retail Manager Surveys

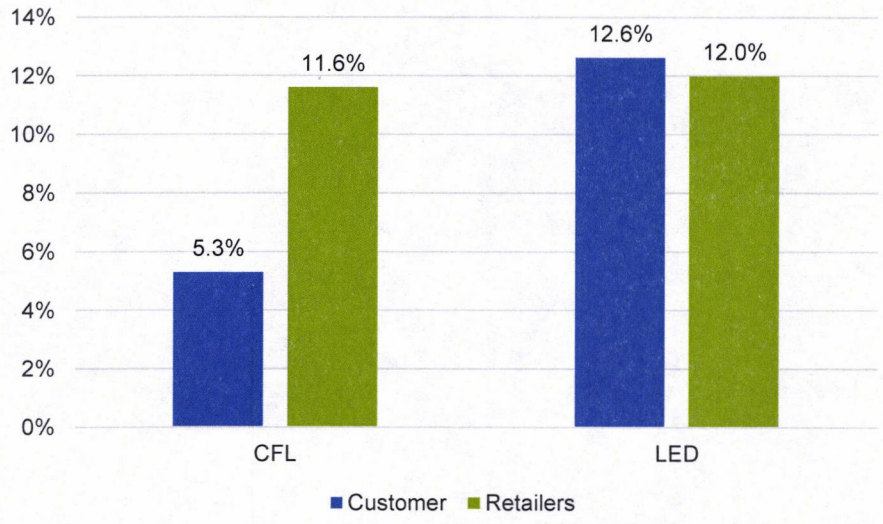
Retail respondents were typically lighting or electrical department managers and had held their position from three months to 20 years, for an average of four years. Overall, the 27 respondents represented stores that sold 75% of all Simple Steps CFLs and 85% of all Simple Steps LEDs. Of the 27 retailers surveyed, 17 could provide an estimate of the number of CFLs sold to nonresidential customers, representing 51% of all Simple Steps CFL sales, and 14 could provide an estimate of the number of LEDs sold in that sector, representing 53% of all Simple Steps LED sales.

The evaluation team calculated the number of Simple Steps items sold to the commercial sector by calculating the mean percentage of Simple Steps items sold to nonresidential customers, weighted by the total number of Simple Steps items sold per respondent. Using the above methods, the evaluation team estimated that 11.6% of Simple Steps CFLs (or 104,019 bulbs) and 12% of LEDs (or 35,476 bulbs) were sold to nonresidential customers.

7.3.2.3 Comparison of Participant/Nonparticipant and Retail Manager Results

Figure 7-9 shows the estimated percentage of Simple Steps lighting sold to nonresidential customers that each data source (customer surveys and retailer survey) produced. The two data sources produced similar values: 12.6% and 12% of LED leakage for the customer and retailer surveys, respectively. The estimates are less similar for CFLs, with values of 5.3% and 11.6% for the customer and retailer surveys, respectively.

Figure 7-9: Estimates of Percent of Products in Commercial Sector



7.3.3 Retailers Experience with Simple Steps

Respondents reported promoting CFLs for longer time periods than LEDs. Fourteen of 27 respondents could estimate how long they had promoted Simple Steps CFLs; responses ranged from three months to six years, averaging 2.2 years. Twelve of the 27 respondents could

estimate how long they had been promoting LEDs and reported promoting Simple Steps LEDs from three months to two years, averaging slightly less than one year.

7.3.4 Other Opportunities for Simple Steps

Retailer respondents did not report many opportunities to improve the Simple Steps program for residential or nonresidential customers going forward. Five of the 27 suggested maintaining or expanding the program's LED offerings. None reported participating in the recent Simple Steps washing machine offering.[72]

[72] Simple Steps, Smart Savings, Appliance Frequently Asked Questions, http://www.simplestepsnw.com/consumer/How%2520to%2520Choose/Appliance%20FAQ

8 Conclusions and Recommendations

The 2014-2015 evaluation shows high levels of program awareness among all of Avista's customers and shows high levels of satisfaction among program participants and contractors. Program participants and contractors were complementary of Avista staff and generally appreciated the opportunities to save money, save energy, and improve their properties that the programs provide. The evaluation also shows that there are areas the programs could enhance to make them better able to respond to the ever changing market conditions in which these programs operate.

The evaluation team concluded the following and provides several suggestions for Avista's programs. This section begins with conclusions and recommendations pertinent across all programs (cross-cutting), followed by nonresidential and small business, and ending with residential specific conclusions and recommendations.

8.1 Cross-cutting

Conclusion 1: Contractors are key program partners.

Contractors are the driving force of Avista's rebate programs, as they inform both nonresidential and residential consumers about Avista's rebate opportunities and convince them to purchase qualifying equipment. The nonresidential contractors also initiate a notable portion of work in comparison to customer-initiated jobs and appear to be playing a larger role in application preparation than in years past. Both nonresidential and residential customers report being highly satisfied with contractors and are taking into account contractor's recommendations on what to install. Although developing a trade ally network is not a priority, there are several things that can be done short of an official network that could result in increased participation and savings.

Recommendations: Increase support for contractors.

Consider the following suggestions to continue strengthening relationships with contractors and to improve their effectiveness in generating program savings:

1. Offer an opt-in mailing list to contractors. Contractors subscribed to this mailing list would receive regular information on program offers, changes, trainings, and other program supporting information. This list would be open to any interested contractor.

2. Promote outreach to contractors: Encourage program staff and account executives to engage further with contractors by continuing and perhaps increasing their involvement with contractor-related resources such as the Northwest Lighting Network. This work can further educate contractors and nudge them to cross-promote the rebate programs to their customers. Additionally, training may help contractors up-sell high efficiency equipment through the program by improving their understanding of and ability to sell high efficiency solutions. Therefore, Avista should continue to support contractors

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attending NEEA's training sessions including their recently launched comprehensive training for lighting contractors and distributors.

3. Share effective messaging or marketing collateral with contractors. Contractors could support program and marketing staff by providing insights into how to best target certain customer types, learn from Avista on how to better target certain customer segments, and possibly promote cross-program referrals and participation. As findings from the evaluation show that most contractors specialize in the nonresidential or residential sectors, even if they serve both, developing sector-specific messaging may be particularly effective.

4. Investigate offering cooperative (co-op) marketing. Co-op marketing can help contractors effectively market the program consistent with Avista's objectives and increase customer perceptions of contractor's credibility and cross-promote other programs.

Conclusion 2: Although Avista and its implementation contractors deliver rebate programs efficiently, promoting the programs further could help maintain or even increase participation.

Several indicators suggest program promotions could be optimized. First, participants and nonparticipants expressed high interest in learning more about Avista's rebate programs, indicating that although they may be aware of Avista's offers, their knowledge is limited. Second, a majority of residential participants who indicated learning primarily about Avista's offers through contractors were not aware of other program opportunities outside the program they participated in.

Recommendation: Develop more abilities to target marketing. For example, cross-promote programs to recent participants by acknowledging their recent participation and informing them of other program opportunities applicable to their home or business.

Recommendation: For residential customers, continue improving messaging in direct mail promotions to better communicate program information since residential customers prefer to receive this information via mail.

8.2 Nonresidential, Including Small Business

Conclusion 3: Although declining participation rates could threaten Avista's ability to achieve long-term goals, evaluation results point to opportunities to drive additional savings.

Developing new strategies to encourage deeper savings or increased participation will be paramount to reversing the decline in participation and achieving long-term savings goals. Almost one-third of nonparticipants reported they will make a building upgrade in the next two years, indicating a continued potential for program participation. In particular, evidence suggests that much opportunity remains for converting lighting from T12s.

Recommendation: Develop a marketing approach specifically targeting replacement of T12 lamps.

The switch to a T8 baseline in 2012 had a dramatic effect on participation because the rebates became far less attractive to customers to upgrade from T12s.[73] While it may not be feasible for Avista to alter the baseline for T12 change-outs, Avista should look into developing targeted marketing strategies for convincing nonresidential customers with T12s to replace them with more efficient lighting, focusing not only on savings but improved lighting quality and performance. Avista could begin by targeting businesses that the Small Business Program has identified as still having T12s.

Recommendation: Work with nonresidential lighting contractors to promote replacement of T12 lamps.

Contractors make their living by selling equipment. Avista should work with nonresidential lighting contractors to make sure they are fully aware of the advantages that more efficient lighting (including the reduced wattage tube lighting that NEEA is targeting through its Reduced Wattage Lamp Replacement Initiative) offer their customers.

Recommendation: Consider claiming Simple Steps savings for bulbs purchased for the nonresidential sector.

The evaluation found that about 12% of Simple Steps LED sales and somewhere from 5% to 12% of Simple Steps CFL sales go to nonresidential customers. The mean hours of use for such lighting is much higher in a nonresidential than residential settings, meaning that the total Simple Steps savings is potentially higher than currently estimated, and at a minimum, Avista should consider claiming the additional savings for these purchases.

8.3 Residential

Conclusion 4: Participation in the Avista rebate programs has rebounded since 2013 driven by a fivefold increase in shell program participation.

Rebate program participation reached a low point in 2013, after which participation increased year over year by 51% from 2013 to 2014 and by 43% from 2014 to 2015. This is a positive sign; however, maintaining or increasing program participation requires cost effective savings opportunities for residential customers. Avista's residential programs operate in a fast-changing market. Consumers are adopting LEDs rapidly,[74] retailers are transitioning away from CFLs to

[73] A very similar thing happened to another program administrator in Missouri. See Ameren Missouri BizSavers Process Evaluation Report 2015.

[74] 1 of 20 A-line bulbs sold nationally was an LED in third quarter of 2014, whereas in the quarter prior to that, it was 1 in 30. This statistic comes from the *2015 LED Market Intelligence* report by Bonneville Power Administration. https://www.bpa.gov/ee/utility/research-archive/documents/momentum-savings-resources/led_market_intelligence_report.pdf

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LEDs,[75] and the federal government and regulators are mandating higher efficiency standards for bulbs and other energy efficient technologies.[76] The convergence of these forces has implications for the cost effectiveness of Avista's downstream rebate programs. Program administrators throughout the United States are exploring and testing alternative program designs such as upstream and midstream designs in response to the evolving market. Although Avista is currently participating in the Simple Steps, Smart Savings program (a midstream program), when asked about future opportunities, program staff did not mention any upcoming pilots or programs that apply these types of designs.

Recommendation: Continue regularly reviewing the expected savings and cost-effectiveness of the measures in residential portfolio and exploring the benefits and costs of other program designs including upstream and/or midstream designs.
Consider these suggestions:

1. Continue monitoring the technological advances and availability of ductless heat pumps and water heating equipment. Surveyed contractors recommended both of these categories as candidates for inclusion in Avista's programs. NEEA, for example, has been working to promote the savings potential of heat pump water heaters in the Northwest via the Northern Climate Heat Pump Water Heater Specification,[77] and The Northwest Power and Conservation Council has identified both of these measure types as promising technologies in the recently adopted Seventh Power Plan.[78]

2. Explore upstream program opportunities outside of the lighting market. Upstream incentive programs offer the potential to increase the adoption of energy efficient technologies at a lower cost compared to downstream incentive programs. Program administrators in California and elsewhere have successfully tested or used upstream program designs for technologies that Avista currently incents, including HVAC equipment and water heaters.[79]

Conclusion 5: Residential customers who rent their home are underserved.

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[75] Souza, Kim, 2016. *Walmart to transition lighting products away from compact fluorescent to LED.* Retrieved from http://talkbusiness.net/2016/02/walmart-to-transition-lighting-products-away-from-compact-fluorescent-to-led/

[76] The lighting standard, established by the Energy Independence and Security Act of 2007, requires that light bulbs use about 25% less energy by 2014. New efficiency heating and cooling standards from the U.S. Department of Energy, which have gone into effect Jan. 1, 2015, will increase the efficiency of heating, ventilation, and air-conditioning (HVAC) equipment in certain regions.

[77] http://neea.org/northernclimatespec/

[78] http://www.nwcouncil.org/energy/powerplan/7/plan/

[79] Quaid, M. and H. Geller (2014). *Upstream Incentive Utility Programs: Experience and Lessons Learned.* Retrieved April 14, 2016. http://www.swenergy.org.

Nonparticipants say living in a rental property prohibits them from making improvements. This was the second most commonly cited barrier to making energy efficient upgrades among nonparticipants (after the up-front cost barrier). More than a quarter (27%) of nonparticipant survey respondents were renters, whereas only 3% of the participant survey respondents were renters. Renters account for about one-third of the population in Avista territory.[80]

Currently, Avista serves renters via the low-income program. The CAP agencies reported having difficulty serving the low-income renter population because it is difficult to convince landlords to participate. Additionally, there appears to be no multifamily program in the Avista portfolio that could serve this market, although Avista does offer an incentive for a natural gas space and water heating measures to multifamily property owners.

Recommendation: Investigate energy savings opportunities in the rental market. Consider the following suggestions:

1. Estimate the number and distribution of rental units in the single family, manufactured home, and among multifamily buildings. Analyzing these data geographically and by vintage would likely yield insights regarding the energy saving potential in these markets.

2. Conduct needs assessment research with landlords to understand their needs and concerns and explore ways to bolster their willingness to make energy efficiency upgrades on their properties. This research should consider the needs landlords serving low-income renters as well as renters not eligible for the low income program.

3. Conduct needs assessment research with renters to understand their needs and the barriers to participation they face. For example, although some energy savings activities may not be appropriate for renters (for example, HVAC system replacement), other activities such as installing energy efficient lighting and/or advanced power strips could be appropriate.

[80] US Census Bureau. "B25003 : Tenure." 2010 – 2014 American Community Survey 5-Year Estimates. Web. 13 April 2016.

Appendix A Opower

Table 1: Average Daily kWh Savings (β) Compared to Nonparticipants from Cumulative and Monthly Lagged Dependent Variable Interaction Models

	Opower Group[1]		Avista Rebate Group[1]		Opower Group X Avista Rebate Group[1,2]	
	β	%	β	%	β	%
Cumulative Model[3]:	**-0.90**	-1.7%	**-1.35**	-1.7%	**-0.56**	-2.3%
Monthly Model[4]:						
October 2013	**-0.85**	**-1.8%**	**-6.94**	**-17.8%**	2.89	9.0%
November 2013	**-1.16**	**-2.0%**	-1.65	-6.5%	**-6.09**	**-9.0%**
December 2013	**-1.31**	**-2.0%**	**-3.64**	**-7.7%**	-3.20	-4.5%
January 2014	**-1.13**	**-1.7%**	**-3.43**	**-5.6%**	**-3.38**	**-6.4%**
February 2014	**-1.14**	**-1.7%**	-0.85	-2.1%	**-8.33**	**-13.5%**
March 2014	**-1.00**	**-1.7%**	**-2.88**	**-4.2%**	-1.71	-5.0%
April 2014	**-0.79**	**-1.6%**	-1.86	-2.8%	-1.11	-3.8%
May 2014	**-0.58**	**-1.5%**	-0.86	-1.3%	-1.45	-4.4%
June 2014	**-0.58**	**-1.3%**	-1.30	-1.4%	0.20	-0.4%
July 2014	**-0.75**	**-1.3%**	-0.39	2.2%	0.48	0.6%
August 2014	**-0.58**	**-0.8%**	1.26	6.6%	-0.03	-1.5%
September 2014	**-0.66**	**-1.2%**	-0.78	0.0%	-0.19	-1.3%
October 2014	**-0.85**	**-1.8%**	**-2.95**	**-5.5%**	0.46	0.3%
November 2014	**-1.20**	**-2.3%**	-1.20	-1.9%	-0.61	-1.5%
December 2014	**-1.60**	**-2.8%**	1.08	1.5%	0.48	0.0%
January 2015	**-1.56**	**-2.8%**	0.12	0.1%	0.49	-0.1%
February 2015	**-1.24**	**-2.5%**	**-2.98**	**-5.1%**	-0.92	-2.1%
March 2015	**-1.16**	**-2.4%**	**-1.83**	**-3.1%**	0.57	0.2%
April 2015	**-0.97**	**-2.3%**	**-1.90**	**-3.3%**	0.37	-1.1%
May 2015	**-0.69**	**-1.6%**	-1.27	-2.0%	-0.29	-2.5%
June 2015	**-0.67**	**-1.3%**	-0.67	0.6%	-0.06	-0.9%
July 2015	**-0.72**	**-1.1%**	-0.70	2.8%	-0.39	-3.2%
August 2015	**-0.53**	**-0.7%**	0.51	4.7%	-1.07	-4.8%
September 2015	**-0.67**	**-1.5%**	**-1.88**	**-2.2%**	-0.12	-3.3%
October 2015	**-0.81**	**-2.1%**	**-3.72**	**-8.0%**	0.26	-1.3%
November 2015	**-1.15**	**-2.4%**	**-3.12**	**-6.6%**	-1.01	-3.6%
December 2015	**-1.81**	**-3.0%**	**-1.49**	**-3.7%**	-1.21	-3.1%
Observations	**2,114,861**					

	Opower Group[1]	Avista Rebate Group[1]	Opower Group X Avista Rebate Group[1,2]
R-squared	**0.37**		

[1] All bolded βs are significant at p≤ 0.10.

[2] βs & percentages are for the interaction term, and the actual values for the Opower+Rebate group are the sum of columns 2, 4, and 6 for βs and the sum of columns 3, 5, & 7 for percentages.

[3] Cumulative lagged dependent variable regression model: *Daily_average_kWh_usage = Opower_participant(β) + Avista_Rebate_participant (β) + Opower_participant (β)*Avista_Rebate_participant (β) + year_month+ daily_average_kWh_preusage + ε*

[4] Monthly lagged dependent variable regression model: *Daily_average_kWh_usage = ([HER_participant_group(β) + Rebate_participant_group(β) + HER_participant_group(β)*Rebate_participant_group(β)] by year_month) + year_month + daily_average_kWh_preusage + ε*

Table 2: Average Daily kWh Savings (β) from Cumulative and Monthly Lagged Dependent Variable Group Comparison Models

	Nonparticipants vs. Opower-only Participants[1]		Nonparticipants vs. Avista Rebate-only Participants[1]		Nonparticipants vs. Opower+ Avista Rebate Participants[1]		Opower-only vs. Avista Rebate-only Participants[1]		Opower-only vs. Opower+Avista Rebate Participants[1]		Avista Rebate-only vs. Opower+ Avista Rebate Participants[1]	
	β	%	β	%	β	%	β	%	β	%	β	%
Cumulative Model[2]:	**-0.90**	**-1.7%**	**-1.60**	**-2.2%**	**-3.30**	**-6.5%**	**-0.48**	-0.1%	**-1.90**	-4.0%	**-1.53**	-4.0%
Monthly Model[3]:												
Oct. 2013	**-0.85**	1.8%	**-7.03**	-17.9%	**-4.92**	-10.7%	**-6.06**	-16.0%	**-4.04**	-8.9%	0.35	4.5%
Nov. 2013	**-1.16**	2.0%	-1.48	-6.3%	**-9.06**	-17.8%	-0.54	-4.5%	**-7.70**	-15.5%	**-6.45**	-10.7%
Dec. 2013	**-1.31**	2.0%	0.01	-2.8%	**-10.51**	-17.4%	-2.37	-5.7%	**-6.82**	-12.2%	**-8.26**	-11.9%
Jan. 2014	**-1.13**	1.7%	-0.83	-2.0%	**-8.40**	-14.3%	-2.41	-4.0%	**-6.81**	-12.0%	**-6.29**	-11.0%
Feb. 2014	**-1.14**	1.7%	-0.82	-2.1%	**-10.44**	-17.4%	0.28	-0.4%	**-9.14**	-15.5%	**-8.12**	-13.4%
March 2014	**-1.00**	1.7%	**-3.09**	-4.6%	**-7.12**	-13.6%	-1.88	-2.5%	**-4.59**	-9.2%	**-3.68**	-8.5%
April 2014	**-0.79**	1.6%	-1.70	-2.4%	**-3.72**	-8.2%	-1.08	-1.2%	**-2.98**	-6.6%	**-2.40**	-6.6%
May 2014	**-0.58**	1.5%	-0.99	-1.6%	**-2.81**	-6.9%	-0.22	0.3%	**-2.35**	-5.7%	-1.83	-5.4%
June 2014	**-0.58**	1.3%	-1.34	-1.5%	**-1.72**	-3.3%	-0.71	0.0%	**-1.08**	-1.8%	-0.38	-1.8%
July 2014	**-0.75**	1.3%	-0.37	2.3%	-0.65	1.6%	0.36	3.5%	0.09	2.9%	-0.26	-0.6%
August 2014	**-0.58**	0.8%	0.80	5.6%	0.24	3.3%	**2.03**	7.9%	**1.40**	5.5%	-0.62	-2.4%
Sept. 2014	**-0.66**	1.2%	-0.69	0.2%	**-1.60**	-2.4%	-0.83	-0.7%	**-1.40**	-2.4%	-0.57	-1.7%
Oct. 2014	**-0.85**	1.8%	**-3.03**	-5.5%	**-3.43**	-7.1%	**-2.07**	-3.6%	**-2.48**	-5.2%	-0.40	-1.5%
Nov. 2014	**-1.21**	2.4%	-1.41	-2.2%	**-3.26**	-6.1%	0.05	0.5%	**-1.75**	-3.4%	**-1.84**	-3.9%
Dec. 2014	**-1.60**	2.8%	-0.40	-0.6%	**-2.63**	-4.9%	**2.69**	4.3%	**1.59**	1.6%	**-2.00**	-4.0%
Jan. 2015	**-1.55**	2.8%	1.37	2.0%	**-1.05**	-3.0%	**1.63**	2.9%	0.62	0.0%	**-1.85**	-4.2%
Feb. 2015	**-1.24**	2.5%	**-3.12**	-5.3%	**-5.20**	-9.8%	**-1.73**	-2.6%	**-3.85**	-7.2%	**-1.83**	-4.1%
Feb. 2015	**-1.24**	2.5%	**-3.12**	-5.3%	**-5.20**	-9.8%	**-1.73**	-2.6%	**-3.85**	-7.2%	**-1.83**	-4.1%
March 2015	**-1.16**	2.4%	**-3.65**	-6.6%	**-4.21**	-8.7%	-0.67	-0.7%	**-1.26**	-2.9%	-0.59	-2.2%
April 2015	**-0.97**	.3%	**-2.04**	-3.6%	**-2.51**	-6.7%	-0.93	-1.1%	**-1.53**	-4.4%	-0.08	-2.1%
May 2015	**-0.69**	1.6%	-1.34	-2.1%	**-2.25**	-6.1%	-0.57	-0.3%	**-1.58**	-4.5%	-0.98	-4.2%
June 2015	**-0.67**	1.3%	-0.79	0.3%	**-1.35**	-1.6%	0.04	1.9%	-0.74	-0.4%	-0.62	-1.9%
July 2015	**-0.72**	1.1%	-0.67	2.8%	**-1.81**	-1.5%	0.01	3.8%	**-1.09**	-0.4%	-1.08	-4.1%
August 2015	**-0.53**	0.7%	0.12	3.7%	**-1.46**	-1.7%	1.20	5.8%	-0.40	0.3%	**-1.60**	-5.5%

	Nonparticipants vs. Opower-only Participants[1]		Nonparticipants vs. Avista Rebate-only Participants[1]		Nonparticipants vs. Opower+ Avista Rebate Participants[1]		Opower-only vs. Avista Rebate-only Participants[1]		Opower-only vs. Opower+Avista Rebate Participants[1]		Avista Rebate-only vs. Opower+ Avista Rebate Participants[1]	
	β	%	β	%	β	%	β	%	β	%	β	%
Sept. 2015	**-0.68**	1.5%	**-1.79**	-1.9%	**-2.68**	-7.0%	**-1.98**	-2.6%	**-2.25**	-6.1%	-0.32	-3.5%
Oct. 2015	**-0.81**	2.1%	**-3.72**	-7.9%	**-4.28**	-11.4%	**-2.91**	-6.0%	**-3.46**	-9.3%	-0.58	-3.4%
Nov. 2015	**-1.15**	2.4%	**-3.25**	-6.7%	**-5.39**	-12.7%	**-1.94**	-4.2%	**-4.09**	-10.1%	**-2.14**	-5.9%
Dec. 2015	**-1.81**	3.0%	**-3.40**	-6.4%	**-6.32**	-12.5%	0.34	-0.6%	**-2.69**	-6.8%	**-3.01**	-6.1%
Observations	***2,067,403***		***450,317***		***478,045***		***1,636,816***		***1,664,544***		***47,458***	
R-squared	***0.37***		***0.50***		***0.49***		***0.38***		***0.38***		***0.42***	

[1] All bolded βs are significant at $p \leq 0.10$.

2 Cumulative lagged dependent variable regression model: *Daily_average_kWh_usage = group1vsgroup2(β) + year_month + daily_average_kWh_preusage + ε*

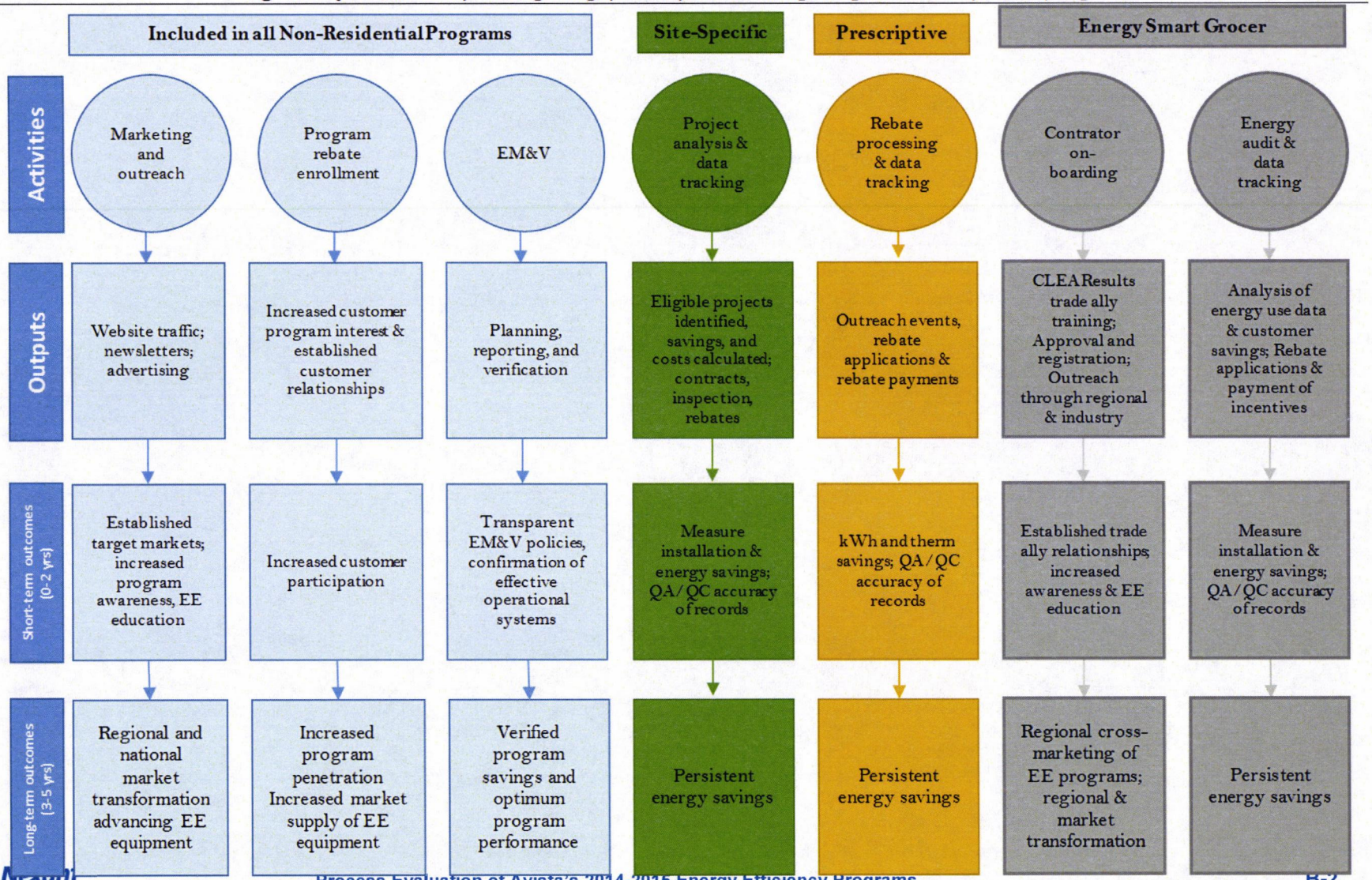
3 Monthly lagged dependent variable regression model: *Daily_average_kWh_usage = group1vsgroup2(β) by year_month + year_month + daily_average_kWh_preusage + ε*

Appendix B Program Logic Models

Avista Nonresidential Natural Gas and Electric Program Logic Model

Data sources: Logic model from the prior evaluation, program documentation, Avista staff

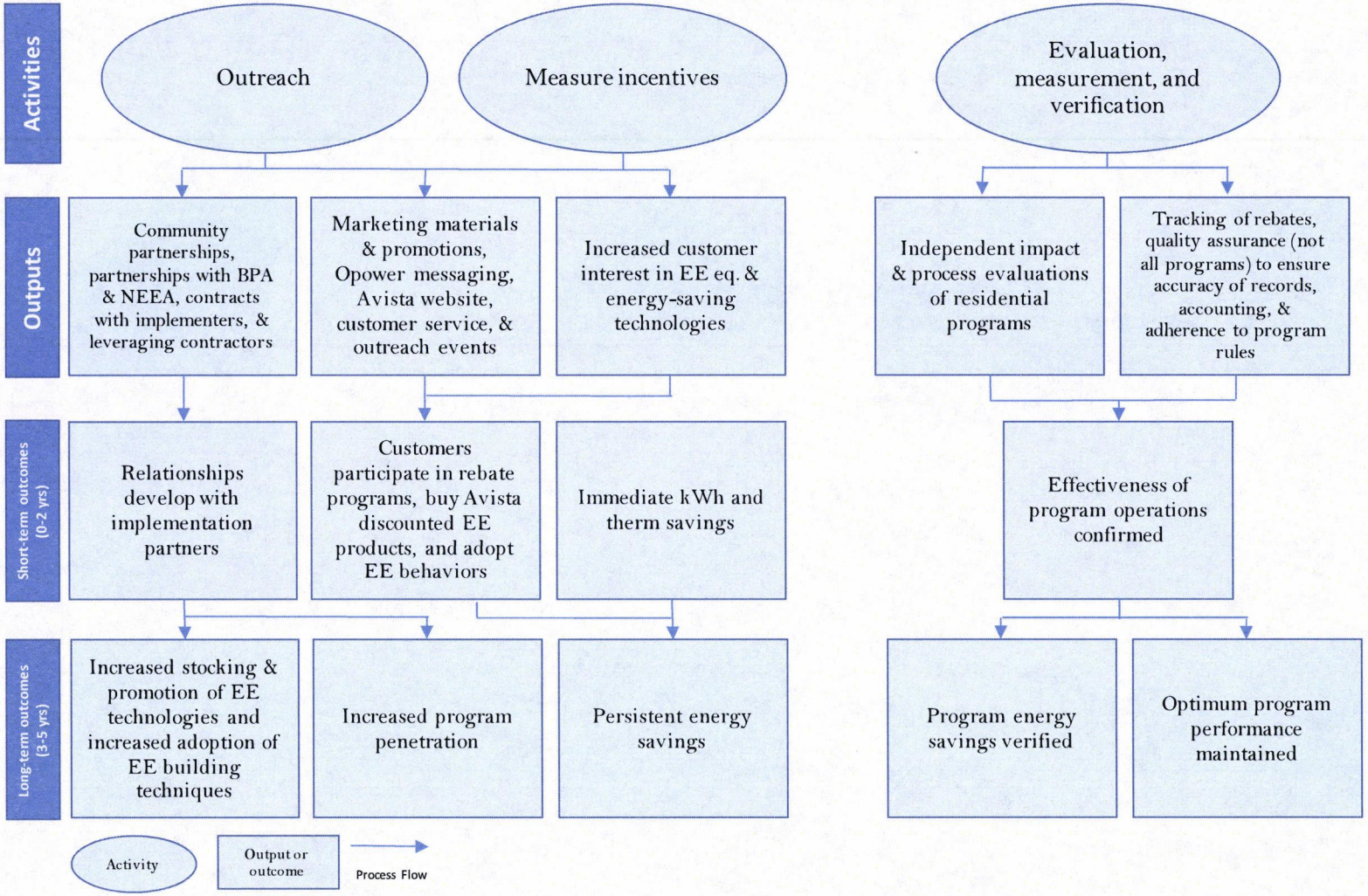
Program inputs: Prescriptive lighting, prescriptive non-lighting, and site-specific programs



Avista Residential Natural Gas and Elctric and Electic-Only Program Logic Model

Data sources: Logic model from the prior evaluation, program documentation, Avista staff , Opower, JACO, and CLEAResult staff

Program inputs: Rebate programs (weatherization and shell, HVAC, conversions, etc.), Simple Steps Smart Savings, Behavior Home Energy Reports, and Appliance Recycling*



* Appliance Recycling program was discontinued in June, 2015.

Appendix C Survey Instruments